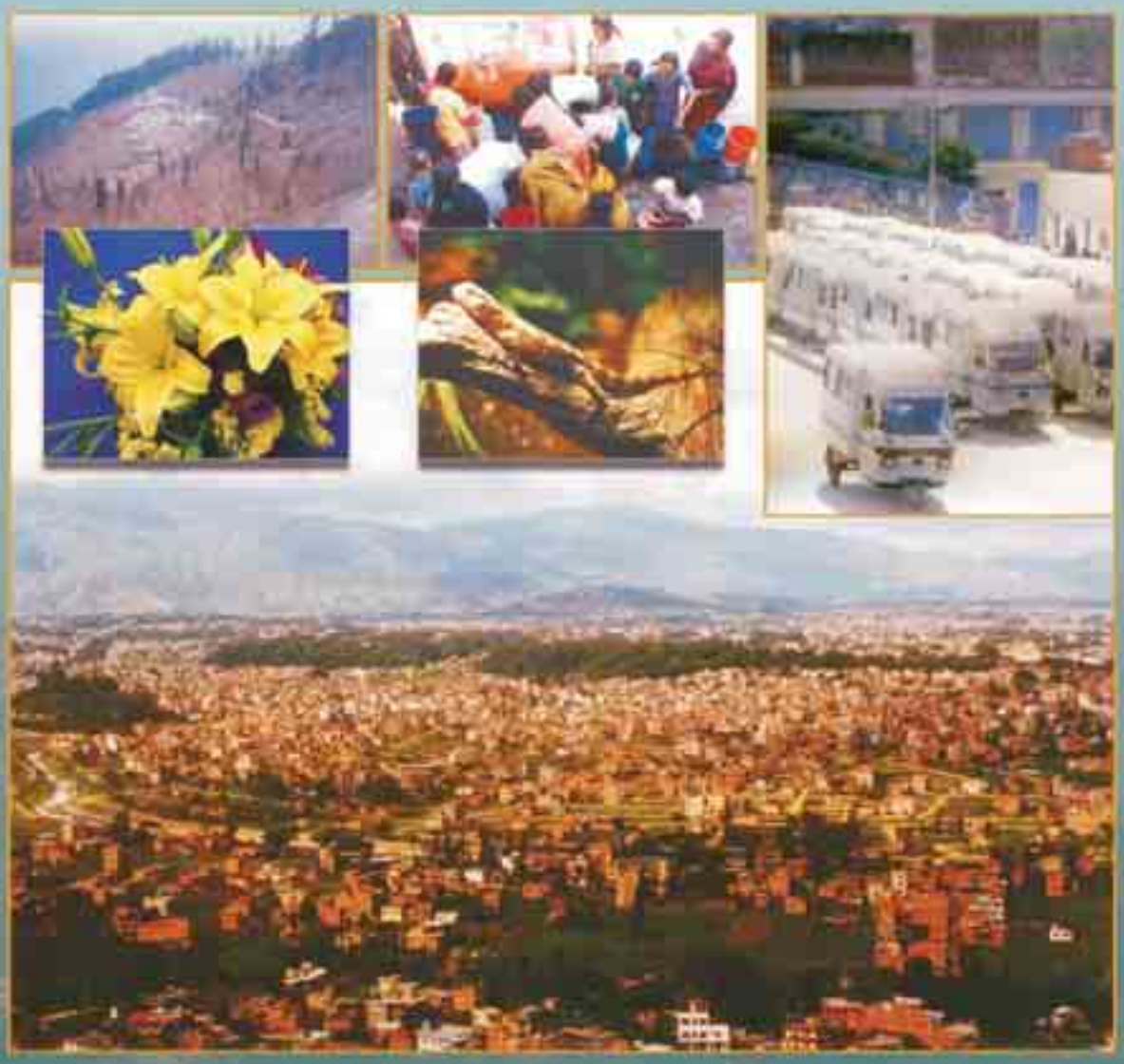
Environment Assessment of Nepal

Emerging Issues and Challenges



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About the Organisations

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The **International Centre for Integrated Mountain Development** (ICIMOD) is an independent 'Mountain Learning and Knowledge Centre' serving the eight countries of the Hindu Kush-Himalayas – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan – and the global mountain community. Founded in 1983, ICIMOD is based in Kathmandu, Nepal, and brings together a partnership of regional member countries, partner institutions, and donors with a commitment for development action to secure a better future for the people and environment of the Hindu Kush-Himalayas. ICIMOD's activities are supported by its core programme donors: the Governments of Austria, Denmark, Germany, Netherlands, Norway, Switzerland, and its regional member countries, along with over thirty project co-financing donors. The primary objective of the Centre is to promote the development of an economically and environmentally sound mountain ecosystem and to improve the living standards of mountain populations.

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International Centre for Integrated Mountain Development

Cover photo:
Background - View of the Kathmandu Valley (*M. Bajracharya*)
Inset - Clockwise from top left - Deforestation (*NEFEJ*);
Water Scarcity (*M. Bajracharya*); SAFA Tempos (*B. Pradhan*);
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Foreword

The critical role of the environment in enabling and sustaining poverty reduction is magnified within mountainous ecosystems such as those found in Nepal. For this reason, the International Centre for Integrated Mountain Development (ICIMOD) was engaged to work with the Asian Development Bank (ADB) and the Government of Nepal to develop this publication.

The ADB's environment policy requires environmental considerations to be mainstreamed not only into investment projects but also into ADB's country and sector strategies. This important thematic work—the country environmental analysis (CEA)—informed ADB's current country strategy and program for Nepal, and provided the basis for the present publication.

The CEA provides an analysis of environmental status and trends in the country; the policy, legal and institutional framework for environmental management; and major environmental issues and opportunities. Review of available documents, update of the relevant information, and consultations with relevant stakeholders were conducted while undertaking the CEA and preparing this publication.

This publication also serves to demonstrate ADB's and ICIMOD's strong commitment to developing south Asia's environment knowledge base further, to disseminating the information widely, and to providing critically needed environment assessment information to policy makers, researchers and development practitioners for the development of economically and environmentally sound ecosystems while improving the living standards of mountain populations.

The report contains a wealth of data and information and highlights key environmental issues, emerging problems, and strategic priority areas. It seeks to provide a critical analysis of the impacts of policy, the status of environmental governance, and financing mechanisms.

This publication is the result of close collaboration between ADB and ICIMOD. Sungsup Ra, the Senior Program Specialist, and Nogendra Sapkota, Social and Environment Officer, Nepal Resident Mission (NRM), supervised the study on behalf of ADB. Basanta Shrestha and Bidya Banmali Pradhan provided overall guidance to the ICIMOD team of consultants comprising Mahesh Banskota, Govinda Raj Bhatta, Bandana Pradhan, and Drona Ghimire. We believe that this publication will be used widely within and beyond Nepal.

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Many institutions provided access to data and information, much of it unpublished. Our special thanks go to the staff of the National Planning Commission, the Ministry of Environment, Science and Technology, the Ministry of Forest and Soil Conservation, and the Central Bureau of Statistics.

We thank Batu Upreti and Sher Jung Shah, previously at the Ministry of Population and Environment, for the valuable suggestions they provided during the preparation of the report.

Several organizations and individuals provided photographs for use in this report and we thank them all, with special thanks to Rakesh Y. Shrestha of Practical Action and Deependra Joshi of the World Conservation Union (IUCN). As far as possible all sources have been credited, we apologize if any were overlooked.

This publication is an outcome of the country environmental analysis (CEA) undertaken by ICIMOD for ADB, and we wish to acknowledge the contribution of all those who contributed to the preparation of the CEA report.

This report could not have been prepared without the support of the staff of ICIMOD's Mountain Environment Natural Resources Information Systems (MENRIS) Division, in particular Gauri Dangol who prepared many maps and figures.

The extensive input of the Publications Unit in ICIMOD's Information Management, Communications and Outreach Section is gratefully acknowledged, in particular A. Beatrice Murray, the Senior Editor, Dharma R. Maharjan, who did the layout and design, and Asha Kaji Thaku, Cartographer/Artist. Matthew Zalichin, the consultant editor, made many valuable suggestions.

Finally the support of the ADB Publications Unit led by Kavita Sherchan was much appreciated. The assistance provided by Arun Rana, ADB, editorial consultant, was crucial for preparing the publication in its final form.

Acronyms and Abbreviations

ACAP	Annapurna Conservation Area Project
ADB	Asian Development Bank
ARI	acute respiratory infection
BOD	biological oxygen demand
BOD5	biological oxygen demand (over 5 days)
CBS	Central Bureau of Statistics
CCCM	Canadian Climate Change Model
CEA	country environmental analysis
CFUG	community forest user group
CHP	Chilime Hydroelectric Project
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CO	carbon monoxide
COD	chemical oxygen demand
COPD	chronic obstructive pulmonary disease
DANIDA	Danish International Development Agency
DDC	district development committee
DFID	UK Department for International Development
DO	dissolved oxygen
EIA	environmental impact assessment
ESPS	Environment Sector Programme Support
EU	European Union
FY	fiscal year
GATT	General Agreement on Tariffs and Trade
GDP	gross domestic product
GEF	Global Environment Facility
GFD3	geophysical fluid dynamics model
GIS	geographic information system
GLOF	glacial lake outburst flood
GTZ	German Technical Cooperation
HDI	human development index
HEI	human empowerment index
ICIMOD	International Centre for Integrated Mountain Development
IEE	initial environmental examination
INGO	international nongovernment organization
IUCN	World Conservation Union
LDF	local development fee
LPG	liquefied petroleum gas
MDG	Millennium Development Goals
MOEST	Ministry of Environment, Science and Technology
MOFSC	Ministry of Forest and Soil Conservation
MOPE	Ministry of Population and Environment
masl	meters above sea level
NEA	Nepal Electricity Authority
NGO	nongovernment organization
NLSS	Nepal Living Standards Survey
NO_2	nitrogen dioxide
NO_X	nitrogen oxides
NORAD	Norwegian Agency for Cooperation and Development
NPC	National Planning Commission
NTFP	non-timber forest product
ODS	ozone depleting substance
OPD	outpatient department
PM10	particulate matter of diameter 10 microns or less

PM2.5	particulate matter of diameter 2.5 microns or less
PAH	polyaromatic hydrocarbon
RS	remote sensing
SAARC	South Asian Association for Regional Cooperation
SACEP	South Asia Cooperation for Environment Programme
SEA	strategic environmental assessment
SO_2	sulfur dioxide
TSP	total suspended particles
UK	United Kingdom
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
US	United States (of America)
VDC	village development committee
WEPCO	Women Environment Preservation Committee
WHO	World Health Organization
WTO	World Trade Organization

Weights and Measures

dBA	decibels A
GJ	Gigajoules
GW	Gigawatt
GWh	gigawatt-hour
GWh/y	Gigawatt hour per year
kWh	kilowatt-hour
mld	million liters per day
ppb	parts per billion
pph	persons per hectare
ppm	parts per million

Currency Equivalent

(As of 28 February 2006)

Currency Unit—Nepalese rupees (NRs)
$1 = NRs 70.75

Notes

(i) The Nepalese calendar year (B.S.) runs from mid April to mid April. Unless otherwise stated, year ranges written in the form 2005/06 denote a single calendar year.
(ii) The fiscal year (FY) of the Government ends on 15 July. FY before a calendar year denotes the year in which the fiscal year ends. (For example, FY2000 begins on 16 July 1999 and ends on 15 July 2000.)
(iii) In this report, $ refers to US dollars.
(iv) In this report, tons (t) refer to metric tons or tonnes (1,000kg).
(v) Acts and Regulations are cited under the name of the ministry from which they originate. The official version of Acts and Regulations is published in the Nepal Gazette (in Nepali). Some Acts and Regulations are published by other Government agencies in English (unofficial translations).

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Chapter 1

Overview

Introduction

There is increasing awareness of the need for reliable environmental information to inform policy and planning for sustainable development. In many countries, however, it can be difficult to discover sources of, or gain access to, the appropriate information—even if it exists.

The Asian Development Bank (ADB) environmental policy requires environmental considerations to be mainstreamed into both investment projects and programs, and country and sector strategies. As a contribution to this, a country environmental analysis (CEA) was prepared in 2004 as an input to ADB's country strategy and program for Nepal. The CEA was prepared by the International Centre for Integrated Mountain Development (ICIMOD) in line with its aim as a mountain learning and knowledge center to gather and disseminate the information needed as a basis for the development of economically and environmentally sound ecosystems while improving the living standards of mountain populations.

The CEA report contained a wealth of data and information that could be relevant for Government agencies, funding agencies, nongovernment organizations, academia, and other concerned parties. Thus ADB and ICIMOD agreed to develop the report further and publish it for a wider audience; the present publication is the result. The aim was both to disseminate the findings of the CEA report more widely, and to provide a broad list of sources that would provide a starting point for future researchers and practitioners in need of environmental data.

Environmental data is still a new and incomplete area in Nepal. It can be difficult both to discover what data are available and to obtain access to them. Relevant data are scattered among many institutions, and are often unpublished. There are many gaps and inconsistencies, problems in data quality, lack of clear information about methods and definitions used, lack of time series, and lack of comparability between different data sets. These issues have been highlighted in the appropriate sections in this book. Nevertheless, the information published here provides a basis for assessing the state of the environment in Nepal, as well as factors like environmental governance, financing, and trade that influence it. The extensive sources listed will provide future researchers with a basis for identifying new sources of data for future work, and it is hoped that the identification of gaps and needs will encourage further development of an "environmental statistics" culture in the country.

Organization

This book is organized broadly into five parts. The first comprises this overview chapter together with Chapter 2, which discusses the relationships among rural environment, poverty, and livelihood. The largely rural population of Nepal is still almost totally dependent on land, forest, and water resources for their livelihood. As resources become depleted or degraded, resource rights, vulnerability, food security, marginalization, and resources-related conflicts have increased. Clashes between traditional and contemporary systems of property rights are often at the root of livelihood insecurity. Other pressures on natural resources come from emerging markets, a growing population, and rapid expansions of different types of infrastructure. While these are an integral part of the present development scenario, environmental problems can no longer be overlooked as people displaced by the loss of environmental resources are easily pushed into conflict situations.

The overall environmental conditions of the country are described in the second part comprising Chapters 3 to 8. The main findings in these chapters is summarised below.

Nepal's forest area in 1986 was 6.2 million ha. According to the most recent survey, based on satellite imagery, the country now has 6.8 million ha of forest and shrubland, with 37% of the land area covered by forest and 9% by shrub. However, these figures do not differentiate in terms of crown cover or other measures of forest health. They may also be higher than in reality (see discussion in Chapter 3). In the absence of other energy sources, fuelwood is the main source of energy for cooking and heating. This has been the main cause of deforestation. The

forests are also used for infrastructure development, such as roads, schools, buildings, and houses. Deforestation has resulted in increased landslides, soil erosion, floods, and loss of biodiversity.

Nepal's 8 bioclimatic zones and 35 vegetation types support a rich biodiversity in terms of fauna and flora. Nepal has more than 100 species of mammals, 800 species of birds, 600 species of butterflies, numerous invertebrates, over 5,000 species of flowering plants, and about 200 ferns. Several of these have become endangered as a result of various factors, including deforestation.

About 18% of the land area has been demarcated as protected and conserved areas. Proper management of the protected areas for biodiversity conservation, poverty reduction, and livelihood improvement is a necessity.

Soil degradation and loss of productive land are serious environmental problems. With the increasing population and growing need for food, agriculture is being expanded to sloping lands and forests. The heavy monsoon rains make fragile mountain slopes vulnerable to loss and degradation of land and soil through landslides, erosion, and river cutting. As much as 5% of all landslides in Nepal are associated with newly-constructed roads and trails.

Solid waste is a common environmental problem in urban areas. The major cities have experienced high rates of population growth and unmanaged urban development, which have resulted in an increasing volume of solid waste. The main sources of solid waste are urban households. Slightly over 14% of the population live in Nepal's 58 municipalities; they generate more than 80% of all solid waste. About two thirds of the waste materials are organic. The impacts of inappropriate solid waste disposal on rivers and human health are substantial. The disposal of waste into local rivers has adversely affected the quality of water and the aesthetic value of rivers and cities. This problem is particularly acute in Kathmandu Valley.

The municipalities are responsible for solid waste management. However, most municipalities do not have adequate resources or the technical expertise to manage solid waste disposal. Solid waste disposal in landfill sites has become socially very sensitive and people's participation in it is generally weak. Lack of suitable infrastructure, such as landfill sites, is also a problem in urban areas.

Nepal is rich in water resources. Over 6,000 rivers and streams drain the country. The rapid increase in population has increased demands for water for drinking, sanitation, irrigation, industry, energy, and recreation. Water shortages and water pollution are serious problems in urban areas because of rural-urban migration, population growth, and unplanned urbanization. The problem of securing a safe drinking water supply is very serious, particularly in Kathmandu Valley.

There is evidence that water quality is deteriorating rapidly in urban areas. Urban areas generally lack the infrastructure for the collection, treatment, and disposal of sewage. Limited facilities built for this purpose are either ineffective or nonfunctional. Drainage is a common problem, particularly in the Terai. As few houses are connected to the wastewater system, untreated domestic waste is discharged into rivers. Most households in rural areas do not have latrines; people defecate in open areas such as riverbanks and public lands. Likewise, most industrial effluents are discharged directly into rivers. All of these practices contribute to surface and groundwater pollution.

Water pollution has become a serious public health problem. Biological water pollution, combined with inappropriate sanitation and hygiene practices, is responsible for diseases such as diarrhea, typhoid, skin diseases, and intestinal worms. These are the most common diseases in Nepal, and a large number of infants die annually due to diarrhea alone. Recently, arsenic contamination of the groundwater of the Terai has become a concern.

Water pollution has also adversely affected aquatic ecosystems. Nepal's rivers have rich aquatic biodiversity, which is threatened due to growing water pollution. The rivers of Kathmandu Valley, particularly in the core city areas, have already lost aquatic biodiversity.

Air pollution is a serious concern in urban areas due to dust generated by vehicles, increasing use of fossil fuels for transportation, and concentration of industries. Air pollution by industrial emission is a local concern in many areas. Kathmandu Valley is especially vulnerable to air pollution due to its topography (a bowl-shaped valley), rapid and haphazard urbanization, and significant increase of vehicular transport in narrow streets. In addition, the poor maintenance of the roads aggravates air pollution by contributing particulate matter to the air.

The transport sector is the largest contributor to total emissions of pollutants in Kathmandu Valley, followed by the household, industrial, and commercial sectors. Gasoline is the largest contributor to the total combined emission of all pollutants, while fuelwood and coal are also major contributors. With the improved technology of brick kilns, pollution from this sector is expected to be reduced in Kathmandu valley. Indoor air pollution due to burning fuelwood in unventilated rural houses also causes serious health hazards.

The third part of the book, Chapters 9 and 10, deals with environmental governance, the evolution of environmental policies, standards regulation, the roles of different stakeholders, and the financing of environmental programs. Weak enforcement of environmental decisions and regulations appears to be the most serious and persistent problem. Despite significant progress in introducing environmental regulations and legislation, the loss of credibility of the Ministry of Population and Environment (MOPE) as an effective environmental organization resulted in its dissolution, with environment functions being moved to the Ministry of Science and Technology. This ministry has been renamed the Ministry for Environment, Science and Technology (MOEST). It has yet to be seen whether the difficulties encountered by MOPE will be successfully overcome by this reorganization. Some of the problems related to poor implementation of environmental decisions are endemic to all government organizations, while others are specific to particular environmental issues.

The fourth part, Chapters 11 to 13, deals with three emerging environmental themes that are quite new in the context of Nepal but are now receiving a good deal of attention. The discussion on environment and conflict shows that conflicts regarding natural resources are widespread in land, forest, and water resources. A new area of environmental conflict is also beginning in urban areas. Some of these problems have remained unresolved and unattended for so long that organizations may be hesitant to 'bell the cat', given the continuing political turmoil and conflict situation in the country. The most surprising revelation is that the Government does not have an established mechanism to address the ongoing conflicts related to natural resources, particularly some aspects of forest resources.

Trade and environment represents a new area that has become important for Nepal since it joined the World Trade Organization (WTO). Some exports from Nepal have already been subjected to environmental barriers by other countries including India. As a relatively new player in this area, Nepal has a lot of catching up to do in terms of improving institutional capacity, technical standards, and quality assurance of its exports; intellectual property rights; market access; trade in services; and comprehensive surveillance of domestic and international trade.

The discussion on environmental information emphasizes the need for monitoring progress and developing appropriate indicators. This has been achieved to some extent by sharing and exchanging data with different organizations. Information must be linked to policy analysis and decisions. This book seeks to make analyzed information available in a form that is easily understood and accessible to policymakers.

Finally, in Chapter 14 the book deals with the emerging strategic issues for Nepal. The first of these is promoting integrated ecosystem management and sustainable livelihoods. The chapter brings together the different aspects of livelihood security in rural areas and argues that further deterioration of rural livelihoods can be prevented by more effective integrated ecosystem management. It focuses on the issues of sustainable use of resource endowments and ecological niches; participatory and collaborative approaches; harnessing ecological, economic, cultural, and institutional opportunities; and promoting decentralized and transparent decision making. The second issue is promoting integrated urban environment management. Urban environmental problems are likely to become serious because of rapid urbanization, poor infrastructure, haphazard management of urban development, and the inadequate resources of urban development organizations. Unless organizations work together within a common framework, urban growth is likely to have a significant negative impact on environmental resources because of increasing air and water pollution, and unrealistic prices for natural resources used by urban residents.

Another priority area is institutional strengthening and capacity building. MOPE was disbanded because it was seen as a weak organization with limited capacity. The critical question now for its successor MOEST is how to strengthen the organization and how and where to build its capacity. The lesson from MOPE's dissolution is that other organizations in the Government have also developed important environmental capacity; the new organization must find a niche that cuts across sectors, that supports sectoral work, and that provides leadership and vision regarding the changing environment and its management in the future. Some of the specific areas where further work is needed include policy reforms, improvements in the legislative system, working with others on trade and environment, and mobilization for stronger enforcement of environmental laws and environmental impact assessment (EIA) and strategic environmental assessment (SEA) recommendations.

The final priority is for an environmental and natural resources information network. The demand for appropriate environmental information is growing. What is available is often dispersed, heterogeneous, inaccessible, discontinuous, and unreliable. This situation added to the difficulty in producing this report, and is responsible for occasional inconsistencies in the data reported here,

as data gathered by different agencies at different times may be based on different definitions and methodologies. Improvements are needed in all these areas including presentation in spatial forms that are recognizable, understandable, and based on reliable evidence. New technology has provided many options for developing new information and has facilitated monitoring over time. There are many opportunities available and decision makers can no longer afford to neglect these in their environmental decisions and actions.

The information provided in the chapters is supplemented with an Annex containing a brief account of Nepal's progress in fulfilling the Millennium Development Goals (MDG) commitments.

Chapter 2

Rural Environment, Poverty, and Livelihood

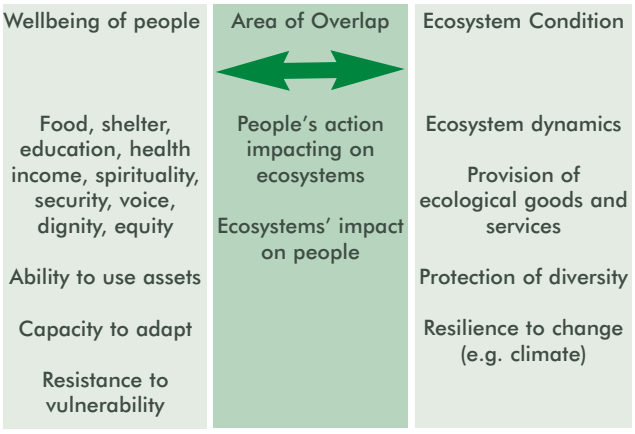
Introduction

"Rural environment" refers to human settlements in rural settings, their surroundings, and their interrelationships. It includes both natural and human-made or cultural environments. The natural environment comprises water, air, soil, forests, pasture, wildlife, and so on, while the cultural environment includes settlements and their patterns, transportation, technology, utilities, services and others. In Nepal, the Ministry of Local Development defines rural and urban localities. Population size is the principal criterion for this designation, but the threshold size of population has changed since the census year of 1952/1954[1]. The present threshold population size for designating municipalities was set in 1996 at 20,000 for the Terai and 10,000 for the Hill and Mountain regions. All settlements with populations below these figures are defined as rural localities.

Rural environments in Nepal vary considerably with variations in altitude. Over the country, elevations range from 90 to 8,848 meters above sea level (masl). For socio-economic purposes, the 75 administrative districts are identified as belonging to one of three regions: the Terai (the mostly low lying area along the southern border), Hills, and Mountains. These regions have significant differences in topography, natural endowments, economic activities, and human occupancy with corresponding implications for biodiversity and development activities.

Rapid population growth, increasing density of settlements, degradation of land, loss of biodiversity, shortage of water, and changing weather events have affected food, health, incomes, and the environmental security of rural people. Livelihoods in rural areas, particularly in the hills and mountains, have been supported by a complex web of dynamic interactions among the physical, cultural, and economic environments. A disruption in any one component can disturb the delicate balance and threaten the livelihood security of rural households.

Figure 2.1: People and Conservation Improving Livelihood and Ecosystems



Source: IUCN Nepal (2002)

Neither nature nor the cultural environment is a static entity—they change continually. However, the present rapid pace of change is very disruptive in rural areas. In areas with improved access, traditional farming systems are quickly moving towards commercial farming, based more and more on external market factors. Where access is poor and difficult and resource degradation has continued, livelihood conditions have actually worsened.

This chapter discusses population growth, settlements, services, and poverty and livelihood in the context of rural Nepal.

Rural Population

Growth and Distribution

Nepal is a rural nation, with over 86% of its 23 million people living in rural areas (as of 2001, Table 2.1). The rural population is one of the fundamental driving forces influencing the environmental resource base of the country. During the last five decades (1952–2001), both the total population and

[1] Two Nepali years, approximately mid April 1952 to mid April 1954

Table 2.1: Population Growth Rates[a]

Census Year	Total Population	Annual National Growth Rate (%)	Rural Population	% of total	Annual Rural Growth Rate (%)
1952/1954[b]	8,256,625		8,018,350	97.11	
1961	9,412,996	1.7	9,076,774	96.43	1.2
1971	11,555,983	2.1	11,094,045	96.00	2.0
1981	15,022,839	2.6	14,066,118	93.63	2.4
1991	18,491,097	2.1	16,795,378	90.83	1.8
2001	23,151,423	2.3	19,922,311	86.05	1.7

[a]Growth rates of population are obtained from the following equation: $r = \frac{\log e\left(\frac{p2}{p1}\right)}{t}$

[b]Census of 1952/54 covered two Nepali years, approximately mid April 1952 to mid April 1954
Source: CBS (2003) pp. 37–85.

Table 2.2: Distribution, Density, and Growth of Rural Population by Region

Region	Rural Area (km^2)	Rural Population Change 1991–2001				% of Total Population 1991	% of Total Population 2001	Rural Density per km^2 2001
		1991	2001	% Increase	Growth Rate			
Mountain	51,661	1,405,113	1,644,154	17.0	1.6	8.7	8.3	32
Hill	59,955	7,289,308	8,567,672	17.5	1.6	45.0	43.0	143
Terai	32,289	8,100,957	9,710,485	19.9	2.6	46.3	48.7	301
Country	143,905	16,795,378	19,922,311	18.6	1.7	90.8	86.1	138

km^2 = square kilometer
Source: CBS (2003) pp. 37–85.

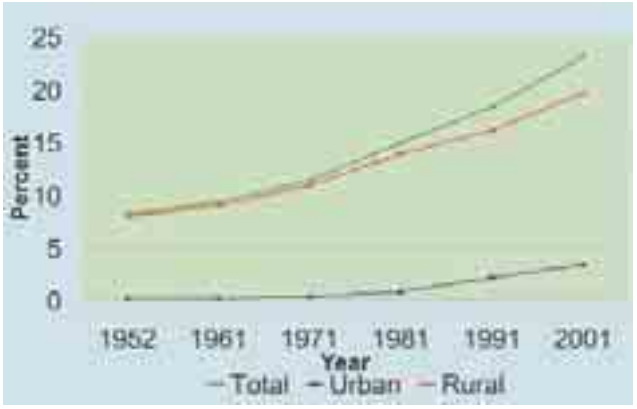
the rural population have increased enormously. In 1952, the country's total population was 8.26 million, with a rural population of 8 million that increased to 20 million by 2001 (Table 2.1). However, the country's annual population growth rates have always exceeded the annual rural population growth rates (Table 2.1; Fig. 2.2). It is estimated that the population will reach 29 million by 2011 (CBS 2003).

Since 1981, national and rural population growth rates have been rapid, putting tremendous pressure on natural resources such as agricultural land and forests. At present, the population density of the country as a whole is 157 persons per square kilometer (km^2). The density on agricultural land is 570 persons per km^2.

Owing to variations in topography, natural resources, cultures, and infrastructure facilities, the Mountain, Hill, and Terai regions exhibit marked variations in the growth and distribution of rural population (Table 2.2). The rural population increased in all three regions between 1991 and 2001, but the growth of rural population in Mountain and Hill areas (17%), was less than in the Terai (29%). The growth rate of rural population in the Terai was 2.6% per year, higher than the growth rate in the two other regions. In both the Mountain and the Hill regions, the growth rate of rural population was less than the growth rate of the national rural population (2.1%).

According to the 2001 census, the Terai—which has the smallest area—has the largest share of rural population with 49%, followed by the Hill (43%) and the Mountain regions (8%). Comparing the relative share of rural population in the regions between the census years 1991 and 2001, the Mountain and Hill regions have shown a decreasing trend and the Terai an increasing trend. As a result, the density of rural

Figure 2.2: National, Rural, and Urban Population Growth Rates, Nepal



Source: CBS (2003)

population in the Terai with 301 persons per km^2 is the highest in the country.

With the lowest density and growth rate of population, the Mountain region has less pressure on its natural resources than the other two regions. For example, the per capita cultivated landholding in the Mountain region is 0.31 hectares (ha) compared with 0.16 and 0.17 ha in the Hill and the Terai regions, respectively (Table 2.3). Likewise, the Terai region has the lowest per capita forest land (0.11 ha), while the Mountain region has the largest per capita forest land. In other words, the Terai has the greatest pressure on both its cultivated and forest resources.

Economic Characteristics

The economically active population above 10 years of age constitutes 45% of the nation as a whole. Of the total rural population, 48% are economically active, compared with 41% in urban areas. In all cases, however, the proportions of economically active population are below 50%, which means that there is a large dependent population.

According to the 2001 census, 66% of the total gainfully employed population is engaged in the primary sector including agriculture, forestry, and fishery. This figure was 81% in 1991. There was a significant increase in employment in the manufacturing (secondary) and commerce (tertiary) sectors between 1991 and 2001. In rural areas, the primary sector employed 72% of the total gainfully employed population as against 42% in urban areas. About 10% and 17% of the rural gainfully employed population are engaged in the secondary and tertiary sectors, as against 18% and 40% in urban areas. The share of the primary sector in the Mountain region is 81%, compared with 68% and 60% in the Hill and Terai regions, respectively. Other important employment sectors in the Hill and Terai regions are commerce, manufacturing, and personal and community services.

Social Characteristics

In the last census in 2001, the literacy rate of the country's total rural population 6 years of age and above (16,428,183) was 52% (Table 2.4), compared with the national literacy rate of 54% (CBS 2002b). The rural literacy rate is higher in the Hill region (58%) than in the Terai (48%) or the Mountains (48%).

The rural sex ratio is 99.8 males per 100 females. The Terai region as a whole has a ratio of 103.8, whereas the Mountain and the Hill regions have ratios of 98.4 and 95.8, respectively. The sex ratio is lowest in the western development region at 93.

The dependent population below 15 and above 59 years of age accounts for 53% of the total rural population. The total fertility rate among women aged 15–49 years is 4.4, which is double the rate of urban women (2.1); the under-five mortality rate in rural areas is 112 per thousand live births vs. 66 in urban areas; contraceptive prevalence in rural areas is 47% among women of reproductive age (15–49) compared with 66% for urban areas; and infant

Table 2.3: Cultivated and Forest Land by Region, Nepal, 2001

Region	Total Area (km^2)	Number of Districts	Per Capita Cultivated Land (ha)[a]	Per Capita Forest Land (ha)[a]
Mountain	51,817	16	0.31	0.70
Hill	61,345	39	0.16	0.30
Terai	34,019	20	0.17	0.11
Country	**147,181**	**75**	**0.18**	**0.24**

ha = hectare; km^2 = square kilometer
[a] No separate data on cultivated land and forest land available at rural level .
Source: JAFTA (2001)

Table 2.4: Literacy Status of the Rural Population (6 years of age and above) [a]

Literacy Category	Mountain		Hill		Terai		Rural Total	
	Number	%	Number	%	Number	%	Number	%
Can't read or write	625,184	51.0	2,965,111	41.9	4,139,386	51.0	7,729,681	47.1
Read only	82,876	6.8	487,617	6.9	487,632	6.0	1,058,125	6.4
Read and write	507,618	41.4	3,588,820	50.7	3,441,026	42.4	7,537,464	45.9
Not stated	10,277	0.8	40,215	0.5	52,421	0.6	102,913	0.6
Total	**1,225,955**	**100.0**	**7,081,763**	**100.0**	**8,120,465**	**100.0**	**16,428,183**	**100.0**

[a]Rural literacy for a district is obtained by subtracting the urban literate population from the total literate population.
Source: CBS (2002b)

mortality rates for rural and urban areas are 79 and 50 per thousand live births, respectively. The data shown in Table 2.5 indicate some of the human development measures and basic facilities in rural and urban areas. Selected measures of human development—including gross domestic product (GDP) per capita, human development index, education index, life expectancy index, gender related indices and human poverty index—show that the performance of rural areas is much poorer than that of urban areas. Similarly, there are marked differences regarding basic facilities such as piped drinking water, sanitation, electricity, fuel used, and mass media exposure. In most cases, the facilities for households in rural areas are fewer than in urban areas. The Nepal Living Standards Survey (NLSS) 2004 (NLSS 2004) indicates that a majority of households consider their access to public services such as health, education, drinking water, electricity, road, post office and telephone as "fair", whereas "bad" ratings range from 15% (education and post office) to 44% (road).

The population of Nepal includes diverse ethnic groups and castes, languages, religions, and cultural traditions. In the Hill and Terai regions, Janjatis populations (ethnic groups) account for 36.5% of the total population and Hindu castes for nearly 59%. Unlike urban areas, the population of rural localities in all regions is characterized by more or less homogenous ethnicity and caste. However, the population of the emerging rural towns and market centers is more diverse.

Migration

Movement of people from one place to another for economic, social, cultural, and other reasons has a long tradition in Nepal. Migration of hill populations increased after the 1950s following the control of endemic malaria in the Terai region and the warm river valleys.

Table 2.5: Performance of Rural and Urban Areas Regarding Basic Facilities and Development , 2001

	Description	Rural	Urban
Demographic Features	Total fertility rate (women aged 15–49)	4.4	2.1
	Current use of contraception (any method)	46.8	66.0
	Childhood mortality (per 1,000 live births)		
	Infant	79.3	50.1
	Child	35.4	16.7
	Under five	111.9	65.9
Human Development Measures	GDP per capita (PPP) $ (2000)	1,094	2,133
	Human development index (2000)	0.446	0.616
	Education index (2000)	0.276	0.568
	Life expectancy index (2000)	0.562	0.769
	Gender related development index (2000)	0.426	0.605
	Gender empowerment measure	0.333	0.443
	Human poverty index (2000)	41.4	23.9
	Malnourishment among children under 5 years (%)	56.3	36.1
Basic Facilities	Piped drinking water (% households)	33.0	55.2
	Sanitation facilities (% households)		
	Flush toilet	6.1	58.3
	Pit toilet	17.1	14.6
	No facility	75.3	20.1
	Other	1.5	7.0
	Electricity connection (% households)	17.4	85.7
	Fuel used (% households)		
	Firewood	94.1	39.1
	Kerosene	2.3	35.8
	Other	3.6	25.1
	Exposure to mass media, newspaper, radio and TV (% hh)	10.3	40.6

hh = households, GDP = gross domestic product, PPP = purchasing power parity, TV = television
Source: CBS (2003) p. 409.

Table 2.6 shows that by 2001, 1.73 million people (or 7.5% of the total population) had migrated to a region different to that of their original birthplace. The Terai region has been the preferred destination for migrants, receiving 77% of the total. The Hill region is the largest source of out-migration with 69% of the total. In terms of net migration, both the Mountain and the Hill regions are losing population, whereas the Terai is gaining. Census reports indicate that the Terai has been a receiving area for migrants for the last three decades. The NLSS (2004) indicates that the migration rate is higher for females (50%) than males (22%).

In terms of rural and urban areas, rural to rural migration was highest, with 68% of total migrants; rural-urban migration second with 26%; and urban to urban migration lowest with 3% (Table 2.7). NLSS (2004) indicates that the rural origin of migration is the largest with 82%, followed by external (13%) and urban origin (6%).

Migration in Nepal is mainly due to family reasons such as marriage and dependency, which accounted for 75% of all migrants (NLSS 2004). Other reasons include easier lifestyle (12%), looking for job (7%), education and/or training (2.6%), and others. This pattern is true across the three regions and rural and urban areas. However, in rural areas, family reasons accounted for 80% of migration compared with 54% in urban areas. Second in rural areas was easier lifestyle (11%), whereas that in urban areas was looking for job (18%).

The volume of migrations with a duration of more than 10 years is 44% (CBS 2003). The share of the Terai region for migrants staying over 10 years is 50%, compared with 37% and 35% in the Mountain and the Hill regions, respectively. For the country as a whole, the distribution of migrants for different classes of duration of stay (6–10 years, 1–5 years, and less than 1 year) is 23%, 28%, and 5%, respectively.

Nepal's population growth is rapid, which is directly and indirectly related to major environmental resources such as agricultural land, forest, and water on which the majority of the population depends for livelihood. Rapid population growth coupled with the manner in which these resources have been used has placed considerable stress on the environment and has in many cases led to accelerated deterioration of both local and regional environments such as deforestation; soil erosion; floods; desertification; degradation of soil quality; and destruction of hydrodams, irrigation canals, and roads.

Rural Settlement

Definition

Officially, the rural population of Nepal refers to those residing in localities lying within the designated village development committee (VDC) areas (HMG 1999). The definition of a VDC as "rural" is purely administrative. The VDCs contain all settlements with populations below the threshhold for designation as a municipality (see Introduction). A VDC contains government offices and development activities to serve the inhabitants. A VDC generally contains more than one settlement locality.

Table 2.6: Migration of Population, Nepal, 2001 [a]

Origin	Destination				% Out-migration	Net Migration
	Mountain	Hill	Terai	Total		
Mountain		125,597	169,825	295,422	17.1	(255,103)
Hill	33,895		1,157,035	1,190,930	68.9	(830,759)
Terai	6,424	234,574		240,998	14.0	1,085,862
Total	**40,319**	**360,171**	**1,326,860**	**1,727,350**	**100.0**	
% Immigration	2.3	20.9	76.8	100.0		

[a] This figure does not include the movement of people within a region.
Source: CBS (2003) p. 134.

Table 2.7: Rural and Urban Migration by Region, 2001

Region	Rural–Rural		Urban–Rural		Rural–Urban		Urban–Urban		Total
	Number	%	Number	%	Number	%	Number	%	
Mountain	42,364	89.0	2,884	6.1	2,150	4.5	188	0.4	47,586
Hill	565,527	51.6	44,851	4.1	424,801	38.8	60,031	5.5	1,095,210
Terai	1,389,956	77.8	55,770	3.1	319,334	17.9	21,206	1.2	1,786,266
Total	**1,997,847**	**68.2**	**103,505**	**3.5**	**746,285**	**25.5**	**81,425**	**2.8**	**2,929,062**

Source: CBS (2003) p. 142.

B. Pradhan

Agglomeration village in the central hills of Nepal

B. Pradhan

Dispersed settlement type village in the central hills of Nepal

Morphological Features

Rural settlements are primarily of two forms: scattered and agglomerated. Scattered settlements are usually small, with large distances between buildings within the locality, as well as between the settlement localities. Agglomerated settlements, on the other hand, are usually large because they contain buildings that are relatively closely spaced or sometimes attached to each other. The density of buildings in agglomerated settlements is usually high. Market towns in rural areas are usually compact, with buildings commonly attached to each other. The rural settlement study carried out by the Central Department of Geography (CDG 2004) indicates that dispersed settlements are found widely across the Hill region. However, in the western Hills some of the settlements inhabited by the Gurung and Magar ethnic groups are of agglomerated form. The rural settlements in the Terai and the Mountain regions are mostly agglomerated or compact. However, the size of agglomerated settlements in the Mountain region is smaller than those in the Terai. In some parts of the eastern Mountain region, rural settlements are mostly in the scattered form.

These settlement forms are chiefly related to the amount and type of available resources, ruggedness of the topography, climatic conditions, amount of infrastructure services, and so on. Dispersed settlements in the Hills are chiefly the result of limited and scattered production resources and habitable environments in the rugged topography. The compact or agglomerated settlements in the Terai result from the abundant land resources and flat topography, while those of the Mountains are due to cold climate and social reasons. Because of poor sanitation and drainage, the environment of compact settlements is mostly unhealthy.

Distribution Pattern

Table 2.8 shows the distribution of settlement localities as reported by the 2001 census. Details of the number of localities by population size class and region, and their total population, for 1991 and 2001 are shown in Tables 2.9 and 2.10, respectively. All rural localities lie below the population size class 20,000–49,999. However, settlement localities in the population size class 10,000–19,999 also contain some designated urban areas, since in Hill and

Table 2.8: Distribution of Settlement Localities , 1991 and 2001

Population Size Class	Mountain		Hill		Terai		Country Total	
	1991	2001	1991	2001	1991	2001	1991	2001
Below 1,000	60	55	12	15	0	0	72	70
1,000–4,999	459	399	1,722	1,477	842	520	3,023	2,396
5,000–9,999	25	73	304	433	432	561	761	1,067
10,000–19,999	0	27	28	53	137	205	165	285
20,000–49,999	0	2	2	18	14	35	16	55
50,000–99,999	0	0	3	3	5	8	8	11
Over 99,999	0	0	2	3	1	2	3	5
Total	**544**	**556**	**2,073**	**2,002**	**1,431**	**1,331**	**4,048**	**3,889**
% Country total	13.4	14.3	51.2	51.5	35.4	34.2	100	100

Source: CBS (2002b)

Mountain districts, urban areas are defined as settlements with a population of 10,000 and over. The total number of settlement localities of this size in 2001 was 285, which included 277 rural and 8 designated urban areas. There were 16 settlement localities in the population size class 20,000–49,999 in 1991 compared with 55 in 2001, of which the number of rural localities was 11 and 21, respectively. The total number of rural areas decreased from 4,015 to 3,831 between 1991 and 2001, while the number of designated urban areas increased from 33 to 58. In 2001, all 544 rural localities in the Mountains were below a population size of 19,999 except for two designated urban areas. The total number of rural areas in the Hills was 1,976 as compared with 1,301 in the Terai. However, the average population size per rural locality is larger in the Terai (7,464) than in the Hills (4,336). The Mountains have the lowest population size per rural locality. The average population size of rural locality for the country as a whole is 5,200.

Increase in population has a direct bearing on the use of environmental resources, and increased demand for these resources causes their further degradation. The rural population and amount of agricultural land are both expanding, but the forest area is diminishing. Diminishing forest area means declining availability of forest products or increasing travel to collect forest products, which eventually affects the sustainability of agricultural production. In the Hills some of the sloping areas have been encroached for cultivation, resulting in landslides,

Table 2.9: Distribution of Settlement Localities and their Population by Region, 1991

Population Size Class	Mountain		Hill		Terai		Total	
	No. of Localities	Population	No. of Localities	Population	No. of Localities	Population	No. of Localities	Population
Below 500	16	5,680					16	5,680
500–999	44	34,028	12	10,290			56	44,318
1,000–1,999	123	192,527	222	374,896	20	35,422	365	602,845
2,000–2,999	168	420,467	595	1,506,155	201	528,968	964	2,455,590
3,000–3,999	115	398,017	561	1,947,370	357	1,248,667	1,033	3,594,054
4,000–4,999	53	237,131	244	359,901	137	1,177,904	661	2,943,691
5,000–9,999	25	155,280	304	1,901,280	432	3,014,438	761	5,070,998
10,000–19,999			28	359,901	137	1,755,500	165	2,115,401
20,000–49,999			2	43,691	14	430,899	16	474,590
50,000–99,999			3	210,527	5	306,892	8	517,419
Over 99,999			2	537,123	1	129,388	3	666,511
Country Total	**544**	**1,443,130**	**2,073**	**8,419,889**	**1,431**	**8,628,078**	**4,048**	**18,491,097**

Source: CBS (2002b)

Table 2.10: Distribution of Settlement Localities and their Population by Region, 2001

Population Size Class	Mountain		Hill		Terai		Total	
	No. of Localities	Population	No. of Localities	Population	No. of Localities	Population	No. of Localities	Population
Below 1,000	55	30,102	15	11,672	0	0	70	41,775
1,000–4,999	399	928,754	1,477	4,976,439	520	2,173,043	2,396	8,066,629
5,000–9,999	73	378,986	433	2,846,041	561	4,133,218	1,067	7,342,730
10,000–19,999	27	314,726	53	704,562	205	2,962,979	285	3,975,237
20,000–29,999	2	35,290	12	282,037	24	590,434	38	907,761
30,000–39,999	0	0	2	65,328	7	254,495	9	319,823
40,000–49,999	0	0	4	174,175	4	190,352	8	364,527
50,000–99,999	0	0	3	199,707	8	628,775	11	828,482
100,000–99,999	0	0	2	319,303	2	279,158	4	621,007
Over 299,999	0	0	1	671,846	0	0	1	683,452
Country Total	**556**	**1,687,859**	**2,002**	**10,251,111**	**1,331**	**11,212,453**	**3,889**	**23,151,423**

Source: CBS (2002b)

soil erosion, and depletion of water sources, further degrading the agricultural land. Declining forest cover causes frequent river floods and siltation, which also degrade agricultural land in the Terai.

Systems of rural settlement have environmental planning implications. Large villages are more flexible than small villages in terms of using environmental resources. Distance is unquestionably the most important constraint in using natural resources. Spatial proximity of villages to these production support facilities is a basic element of their effective use and hence efficiency in agricultural production (Pradhan 2004). Rural settlements in the Terai are usually bigger than those in the Hills. The scattered settlements of the Hills are neither viable for sustainable use of facilities related to the development of environmental resources nor feasible for providing consolidated force to communal development. While the Terai's agglomerated villages allow a considerable degree of flexibility in the provision of facilities, they may also invite overcrowding and environmental problems such as poor drainage and sanitation. Villages along the riverbanks in the Terai are very vulnerable to floods.

Rural Infrastructure and Services

Infrastructure and services related to the rural environment include roads, electricity, irrigation, health, and education. Data on these infrastructures and services are available at district level; their accessibility is analyzed in terms of trend, distribution, and density.

Roads

Roads are a basic infrastructure for development in Nepal, they include all types of roads: bitumen, gravel, and earthen. The total road length in 2002 was 16,835 km compared with 13,400 km in 1998 and 6,000 km in 1985. The Terai region has slightly over 50% of the total road length. Its density of 25 km road per 100 km^2 area is more than double the country average (Table 2.11). The Mountain region has a mere 1.4 km road per 100 km^2 area.

The total rural area of Nepal is 143,905 km^2 and the urban area is 3,276—98% and 2% of the total area of the country. The rural road density is 10.2 km road per 100 km^2 area, which is almost seven times less than the urban road density. The Terai region has the largest rural road density with 22.7 km per 100 km^2. Many parts of the rural Hill and Mountain regions are not accessible by road.

At present, the road network has connected 61 of 75 district headquarters. The effort to connect the remainder of the district headquarters by roads has been slow because of limited resources. Road construction in Hill and Mountain districts requires huge investment in both construction and maintenance. Although roads can be advocated on social grounds, this sector has yielded low economic returns and suffers from low traffic volume and lack of an integrated development approach.

Though roads have provided beneficial impacts on social and economic environments, these benefits have been accompanied by a number of adverse environmental impacts such as landslides, slope instability, soil erosion, and roadside runoff. While the negative environmental impacts of roads have often been the result of using construction techniques that are incompatible with naturally dynamic and fragile slopes, there have also been many cases of simple mitigation measures being employed (DOR 2000). "Green roads" based on bio-engineering principles and techniques (use of living plants and plant-derived materials in conjunction with inert structures for preventing failure of roadside steep slopes, limiting erosion and gullies, controlling runoff, and so on) that are practical, durable, economical, and environmentally sensitive (Schaffner 1987; DFID 1998; CDG 2001) should be adopted in Nepal.

Electricity

Table 2.12 shows the distribution of electricity connections to households. Less than 40% of households overall have electricity. The Hill region has electricity connections in nearly 43% of households; whereas nearly 80% of Mountain households do not have electricity. In 2001, electricity

Table: 2.11: Road Density by Region, Rural Area and Urban Area

Region	All Roads (km)		Rural Roads (km)		Urban Roads (km)	
	Length	per 100 km^2	Length	100 km^2	Length	100 km^2
Mountain	740	1.4	725	1.4	15	9.6
Hill	7,588	12.4	6,591	11.0	997	71.7
Terai	8,507	25.0	7,321	22.7	1,186	68.5
Total	**16,835**	**11.4**	**14,637**	**10.2**	**2,198**	**67.1**

km = kilometer , km^2 = square kilometer
Source: DOR (2002)

was provided to 17% of rural households compared with 86% in urban areas (CBS 2002b), though a recent survey has shown improving electricity connections in both rural (27%) and urban (87%) areas (NLSS 2004). The national rate of service increased from 14% in 1995/96 to 40% in 2001. Most rural households use other sources of energy such as fuelwood and kerosene for lighting and cooking.

Bhaktapur (Hill district in the central region) has the largest percentage of electricity connected households with 97.4% and Dolpa (Mountain district in the mid-west region) has the lowest with a mere 0.59% of households.

The current production capacity of 527.5 megawatts is a mere 0.63% of the total theoretical hydroelectricity potential of 83,000 megawatts and 1.26% of the economically feasible potential of 42,000 megawatts. In order to increase the access of electricity and to increase production in agriculture and other activities, the current Tenth Plan (2002–2007) has set several targets: (a) to construct 842 megawatts of electricity capacity, (b) 2,600 village development committees to be supplied with electricity through the national grid on the basis of equitable distribution, and (c) annual per capita electricity consumption to be raised to 100 kilowatt-hours. One strategy envisaged in the current plan is to develop electricity through investment by both the private and public sectors.

Electricity is a clean energy. Harnessing the economically feasible hydroelectricity in Nepal, as stated above, involves the construction of large reservoirs. But there have been big debates over macro (mega) and micro hydro projects. Construction of large reservoirs for power generation in the Hill region of Nepal can have negative impacts on the environment and ecosystem. Some of the major environmental and ecological problems of large dams, which impound large volumes of water, are reservoir siltation, land submergence, displacement of people, resource use conflicts, effects on natural aquatic and river habitats, local climate change, increase in incidence of landslides from steep hill slopes, water logging and salinity, and watershed disturbance. In order to mitigate these environmental consequences, measures such as watershed management and protection of upstream areas need to be adopted during the construction phase. On the other hand, micro-hydro projects ($\leq$100 kW) will have advantages on the following criteria (Amatya and Shrestha 1998): (a) relatively low capital investment requirements, (b) short construction period, (c) favorable local geography for micro-hydro potential, (d) simple operation, (e) distribution of micro-hydro projects in numerous locations, (f) use of indigenous technology of Nepali manufacture, and (g) government incentives in the forms of loans and subsidies. Further, micro-hydro projects appear to be much more feasible than macro-hydro projects in terms of environmental conservation and ecological balance.

Irrigation

The distribution of irrigation in 2000, the most recent year for which reliable statistics are available, is shown in Table 2.13. The irrigation capacity is expressed in terms of percentage of cultivated area of the district. A total of 829,788 ha (28% of the cultivated area) was irrigated by means of canal (permanent and seasonal), tube well or bore, pond or tank, and other means; in 1992, total irrigated land was only 504,482 ha.

The total cultivated area is 20% of the area of the country as a whole; the Terai has the largest proportion of cultivated area with 40% and Mountains the least with 5%. The Terai also has the highest proportion of irrigated area (50%) relative to its cultivated area and Mountains the lowest with 8%. More than 50% of the irrigated area is by seasonal canal.

In terms of individual districts, Mugu (mid-western Mountain district) with only 85 ha has a mere 0.7% of its total cultivated area irrigated, while Morang (eastern Terai district) has 96% of its cultivated land irrigated. The cultivated area as a percentage of district area ranges from 71% in Jhapa (eastern Terai district) to 0.36% in Manang.

Irrigation is a fundamental infrastructure for agricultural development in Nepal. At present, the agricultural sector is still very dependent on the monsoon rains due to lack of adequate irrigation. As

Table: 2.12: Electricity Connection to Households

Region	Number of Households		
	Total	Electricity	%
Mountain	285,213	60,630	21.26
Hill	1,951,191	834,789	42.78
Terai	1,938,053	749,080	38.65
Nepal	**4,174,457**	**1,644,499**	**39.39**

Source: CBS (2002b)

Table 2.13: Irrigation Facilities , 2000

Region	Cultivated Area (CA)		Irrigated Area	
	(ha)	%	(ha)	% of CA
Mountain	275,948	5.33	21,909	7.94
Hill	1,274,759	20.78	120,454	9.45
Terai	1,367,864	40.21	687,425	50.26
Nepal	**2,918,571**	**19.83**	**829,788**	**28.43**

ha = hectare, CA = cultivated area
Source: MOAC (2001)

80% of the population depends on agriculture, the development of this sector will help uplift the living standards of a majority of the population. The Agricultural Perspective Plan (1995–2015) incorporates irrigation as one of the main input priorities in its strategy. The National Water Resource Strategy adopted in 2002 has aimed to provide year-round irrigation to 60% of the irrigated land by 2007, and 80% and 90% by 2017 and 2027, respectively. The major challenge for the agricultural sector is to reach the target of 60% irrigated land from the present 28% within 2 years. A new irrigation policy formulated in 2003 aimed to: (a) provide year round irrigation service to the irrigable land by effectively utilizing the country's water resources, (b) develop the institutional capability of water users' associations for the sustainable management of existing systems, and (c) enhance the knowledge, skills, and institutional working capability of irrigation professionals, water users, and nongovernment associations relating to the irrigation development sector.

The Chitwan Irrigation Project is a pumping irrigation system in which the water of the Narayani River is lifted by pump. This project was considered a failure, as its reservoir and main canals were filled with fine sand after only 3 months of operation in 1984.

Source: KES (1986) p.129.

Irrigation development has environmental impacts in both the Hills and the Terai. Expansion of irrigation canals in the Hills and the Terai to cover all irrigable land may lead to several environmental problems summarized below (Adiga 1998).

In the absence of adequate watershed conservation, the use of dynamite in constructing contour canals along hill slopes causes slope instability, rock falls, landmass movements, and canal damage, disturbing the natural state of the habitat.

With the increased network of canal systems in the Hills and Mountains, water leakage and drainage problems may damage the physiography of the terrain causing soil erosion, whereas siltation problems may occur in the Terai.

Increased use of agro-chemicals together with irrigation water may further degrade the quality of soil, the water table (through seepage), and surface water (through runoff).

A considerable number of Terai inhabitants are being affected by arsenic contamination in groundwater. In the Terai, groundwater pumped for drinking purposes is also used for irrigation. Use of arsenic contaminated water not only affects crops but also results in the accumulation of arsenic in topsoil, which may again be harmful. Arsenic contaminated soils are a major source of contamination in the food chain through plant uptake and animal consumption and water supplies (Sijapati et al. 2004).

The following environmental mitigation measures are suggested.

- Water resources development and watershed management are closely linked. The success or failure of an irrigation project depends upon the upstream watershed condition of the project site. Watershed conservation and management should be an integral part of irrigation infrastructure development activities.
- Trees must be planted in and around farmland to reduce soil erosion, to decrease sediment in reservoirs and streams, to enhance the protection of wetlands and forest, and to preserve the long-term productivity of the land.
- Considerable financial resources have to be mobilized for environmental conservation.
- To sustain water sources and prevent sedimentation, impact assessments must be carried out for irrigation and other water-related projects (drinking water and hydropower) on project areas both upstream and downstream of the headwork.
- To alleviate pollution concerns, chemical fertilizers must be made a less desirable substitute for soil productivity, and conservation and public policy must subsidize organic fertilizers and soil erosion control techniques at the farm level.
- Environmental awareness campaigns should be intensified.
- To mitigate arsenic contamination in groundwater, innovative dug well (wide brimmed dug wells over 50 years old being converted to sanitary dug wells) with technical improvements such as slab cover, ventilator, wall sealing and raising of well wall, and arsenic removal filter should be adopted.

Health Services

The health services of Nepal include hospitals, health centers, health posts, and ayurvedic clinics. The distribution of health services by region is shown in Table 2.14 based on a 1999 Department of Health Services report, the most recent year for which reliable statistics are available. The distribution is uneven among regions. The Hill region has the highest percentage of health services. On average, one health service unit for the country as a whole covers 3.3 km^2 and serves 4,169 persons. In terms of area coverage, the Terai region has relatively better accessibility with one health service unit for 2.7 km^2,

Table 2.14: Health Service Accessibility

Region	Distribution of Health Services		Health Service (HS) Units and Population		Health Service (HS) Units and Area (km^2)	
	Units	%	Pop/HS	HS/10,000 Pop	Area/HS	HS/100 km^2
Mountain	620	13.95	2,336	3.67	5.7	1.20
Hill	2,323	52.25	3,642	2.27	3.1	3.79
Terai	1,503	33.81	5,741	1.34	2.7	4.42
Nepal	**4,446**	**100**	**4,169**	**1.92**	**3.3**	**3.02**

km^2 = square kilometer, HS = health service, Pop = population
Source: DOHS (1999)

Table 2.15: Education Accessibility

Region	Distribution of School Services		School Units (SU) and Population		School Units (SU) and Area (km^2)	
	Units	%	Pop/SU	SU/1,000 Pop	Area/SU	SU/100 km^2
Mountain	3,460	10.17	488	2.05	14.98	6.68
Hill	20,895	61.41	491	2.04	2.94	34.06
Terai	9,671	28.42	1,159	0.86	3.52	28.43
Nepal	**34,026**	**100.0**	**680**	**1.47**	**4.33**	**23.12**

km^2 = square kilometer, Pop = population, SU = school unit
Source: DOE (2000) pp. 4-9.

whereas the Mountain region has the fewest health facilities where one health service unit covers 5.7 km^2. The health services in the Terai have the greatest coverage of population (1.34 health service units (HS)/10,000), while the Mountain region has the lowest (3.67 HS/10,000 population).

Although the number of health facilities has increased each year, because of the exponential growth of population, health services are still too few and too far apart. There are few data available regarding the quality of these health services.

The basic challenge of the health sector is to improve access to and the quality of health services for the poor people in rural and remote areas. The major aspects of quality health service delivery are availability of health service units, medicines, and health personnel across rural regions; and generation of awareness of preventative methods. The latter are related to education, awareness, nutrition, and health and sanitation. One important but very ambitious policy formulated in the Tenth Plan is to make effective medicine available to poor backward communities year round through community insurance, cooperation, and partnership.

Education

Education services consist of all school types (public, community, and private) at all levels including primary, lower secondary, and secondary. Education facilities are measured for a district as a whole. Table 2.15 (based on the most recent reliable data available) shows that slightly under two-thirds of schools are located in the Hill districts, with one school serving an area of about 2.94 km^2. The school density in terms of area per school is lowest in the Mountain region, approximately 15 km^2 per school. But the Mountain region has an average of only 488 persons per school, whereas the Terai has 1,159 persons per school, far above the national average. This indicates that there is large population pressure on schools in the Terai districts.

There is a marked variation in school accessibility by district. Manang district has the smallest number of schools with 30 and Kathmandu district the most with 3,296. In terms of area, Kathmandu (Hill district) is the most accessible with one school serving an area of 0.12 km^2, and Manang (Mountain district) the least with one school serving an area of 74.87 km^2. Mustang (Mountain district) has the most schools per population served, one per 230 people, and Dhanusa (Terai district) the least, one per 1,691 people.

Most rural people are still illiterate, especially in poorer communities. The Tenth Plan has given priority to programs of literacy, and primary, non-formal, and technical education. The main slogan of the education sector is "Education for All". Some of the strategies envisaged by the current plan are to develop inclusive and integrated education systems in line with the concept of special needs education for groups with disabilities.

Summary

The above summaries of roads, electricity, irrigation, health, and education indicate a steady increase in providing these facilities in rural areas. However,

provision remains inadequate because of the exponential growth in population. Furthermore, the provision of the facilities in rural areas is grossly inadequate compared with urban areas. The distribution of facilities is also uneven by region. The Terai appears to be more accessible for services than the Hill and Mountain regions. In addition, there is little information available on the actual quality of the services.

The five services can be divided into two broad groups. The first group includes road, electricity, and irrigation, which are fundamental infrastructure for rural development in Nepal. Although provision of these infrastructures has provided beneficial impacts on social and economic environments, their availability in rural areas is too low and the efforts to provide them have been slow because of limited resources. On the other hand, development of these infrastructures has also been accompanied by a number of adverse environmental impacts such as landslides, slope instability, soil erosion, siltation, and loss of habitat and biodiversity. These negative environmental impacts have often been the result of incompatible techniques used for naturally dynamic and fragile slopes. Roads, electricity, and irrigation are interlinked. Watershed conservation and management should be an integral part of developing these infrastructures. Impact assessments for infrastructure projects should not only be carried out in situ but also in other potentially affected areas. Construction technologies for these infrastructures should be environmentally friendly (green roads, micro-hydro, and so on). Management and operation of these infrastructures should be by users' groups.

The second group includes health and education services, which are also fundamentals for environmental conservation and rural development. Most rural people depend directly on natural resources for their livelihoods, and the wellbeing and future of this society depends on its ability to live in harmony with the natural environment. Poor accessibility to health and education services is a major constraint to socioeconomic development efforts in Nepal. The majority of rural people are still illiterate, this is the challenge for education. The challenge to the health sector is to improve access and quality of health services for rural people. These services should be provided adequately in rural areas, with due attention given to sustainability.

Health and Sanitation

Rural Health

Quality drinking water and sanitation facilities are basic human needs. Development of this sector will have positive impacts upon health, and healthy workers will contribute to the growth of other productive sectors. Safe drinking water will significantly control waterborne diseases and minimize health expenses incurred in treating such diseases. Access to drinking water sources is important, as it relates to the time spent fetching water. The saved time can be utilized in productive work, in turn providing opportunities to earn more income and reducing poverty. Development of the drinking water sector contributes to healthy workers, additional income generation, and less health expenditure on treatment of diseases. In rural Nepal, many diseases are related to poor water and sanitation. Sanitation in rural Nepal can be described in terms of access of people to toilet types and wastewater generation and management, the condition of which indicates the state of environment.

Different parameters directly and indirectly related to health and sanitation are discussed in terms of rural and urban areas, and mountain, hill, and Terai regions.

Table 2.16 shows various health indicators contrasted between urban and rural areas. The performance of the selected health indicators is universally less in rural areas than in urban areas.

Table 2.16: Selected Health Indicators

Description	Urban	Rural	Nepal
Total fertility rate women age 15 –49 (expressed/woman) [a]	2.1	4.4	4.1
Current use of contraception (any method) — married men [a]	66.0	46.8	—
Chronic malnourishment of children under 5 years of age (%)	36.6	51.5	50.5
Life expectancy at birth	64.53	60.61	60.98
Population without access to safe water (%)	11.46	22.19	20.48
Population with access to sanitation (%)	77.06	32.05	39.22
Childhood mortality per thousand live bi rths			
Infant [a]	50.1	79.3	—
Child [a]	16.7	35.4	—
Under-5 [a]	65.9	111.9	—

— = not available
Source: UNDP (2001), [a]MOH/New Era/ORC Macro (2002)

The indicators for some common diseases are computed in terms of outpatient department (OPD) visits by region (Table 2.17). There are nine common waterborne and air (smoke) borne diseases. Compared with the national average, the relative incidence of skin disease among hospital outpatients is higher in the Terai, and that of intestinal worms, acute respiratory infection (ARI), gastritis, chronic bronchitis, and typhoid are lower than the national average. These diseases are most likely to occur as a result of poor quality drinking water and lack of nearby health facilities.

Table 2.18 lists the top ten diseases identified by the Department of Health Services of Nepal and Table 2.19 the incidence of diarrhea and ARI in children. Diarrhea among children below 5 years of age is more prevalent in the Mountains and the Terai than the national average (177 per 1,000). Diarrhea is related to the consumption of poor quality water. ARI is more prevalent in the Terai. In rural Nepal, ARI is related to the lack of outlets for smoke from solid biofuels due to poor ventilation. About 95% of rural households use solid fuel, including wood, cow dung, leaves, and straw, for cooking and heating (Table 2.20). The studies of Nepal Health Research Council (2003) and the Intermediate Technology Development Group (2004) show that ventilation is very poor in rural households and smoke from the use of solid fuel remains indoors for long periods, which could be increasing respiratory problems.

According to the Department of Health Services annual report 2003, based on the data recorded in the health services, the percentage of malnourished children below age 3 measured in terms of underweight is higher in the Mountain and Terai regions than the country average (Table 2.21).

Table 2.17: Common Diseases by Region

Diseases	Annual Incidence of Specific Disease (of OPD Visits) [a]			
	National (*N*=8,642,852)	Mountain (*N*=807,663)	Hill (*N*=4,091,291)	Terai (*N*=3,743,898)
Skin disease	175.3	116.7	136.6	229.5
Diarrheal disease	101.4	112.1	105.0	95.2
Intestinal worms	92.6	113.9	100.0	80.0
Acute respiratory infection	87.2	104.5	97.5	72.4
Gastritis	58.2	63.9	63.4	51.3
Chronic bronchitis	30.4	31.0	32.9	27.5
Anemia	28.1	22.5	26.2	31.3
Typhoid	28.0	32.5	27.2	27.9
Jaundice and infectious hepatitis	3.5	2.7	3.0	4.1

N = number, OPD = outpatient department
Note: Figures in parentheses for each ecological region are OPD visits.
[a]Annual incidence of specific disease —number of specific cases in a specific year x 1,000 per total number of OPD visits in the same year.
Source: DOHS (2003)

Table 2.18: Ten Leading Diseases, 2001

Disease	National (*N*= 8,642,852)	Percent of Total OPD Visits by Region		
		Mountain (*N*= 807,663)	Hill (*N*= 4,091,291)	Terai (*N*= 3,743,898)
Skin disease	5.76	5.38	5.18	6.35
Diarrheal disease	3.44	5.00	3.94	2.73
Acute respiratory infection	3.38	4.69	3.69	2.90
Intestinal worms	2.76	4.44	2.99	2.28
Pyrex	2.30	2.58	2.16	2.37
Gastritis	2.20	3.14	2.56	1.71
Ear infection	1.56	1.89	1.45	1.61
Chronic bronchitis	1.20	1.41	1.36	1.02
Abdominal pain	1.05	1.40	1.13	0.93
Sore eye complaints	1.02	1.89	1.22	0.71

Note: Figures in parentheses indicate total OPD visits
Source: DOHS (2003)

Malnutrition remains a serious obstacle to survival, growth, and development in Nepal. There are different forms of malnutrition. The most common forms in Nepal are protein-energy malnutrition, iodine deficiency disorder, and deficiencies of iron and vitamins. The Nepal Demographic and Health Survey conducted in 2001 showed that 51% of the sample children (N = 6877) below 5 years of age were affected by stunting (short for their age), which can be a sign of early chronic under-nutrition. The survey also found that 46% of children below age 5 are underweight (low weight for age). In addition 9% are wasted (thin for their height), an indicator of acute malnutrition. According to the survey (2001), one important cause of protein energy malnutrition in Nepal is that 30%–50% of children are born with low birth weight (weight below 2.5 kg). Low birth weight also leads to an intergenerational cycle of malnutrition (DOHS 2003).

Improvement Measures

Table 2.22 lists health indicators and their status and target by the current Tenth Plan. Increasing the availability of essential health services from 70% to 90% by the end of the Tenth Plan (2007) necessitates increasing the number of health institutions in rural Hills and Mountains, given the scattered settlements.

The Expanded Programme on Immunization is considered one of the most cost-effective health interventions. The present program covers all 75 districts of the country with appropriate interventions to achieve the targets.

The Ministry of Health has developed a Second Long Term Health Plan 1997–2017. The aim of this plan is to guide health sector development in improving the health of the population, particularly those whose health needs are not now met. According to the plan, priority is to be given to health promotion and prevention activities based on primary health care principles. It identifies essential health care services that address the most essential health needs of the population.

Further, the strategy includes not only curative care interventions but also preventive components. The Convention on the Rights of the Child states the right of the child to enjoy the highest attainable standard of health and to have access to health services. In this sense integrated management of childhood illness has been successful in

Table 2.19: Incidence of Diarrhea and Acute Respiratory Infection (ARI) per '000 Population Below 5 years of Age

Region	Number of Diarrhea Patients	Number of ARI Patients
Mountain	195	215
Hill	167	180
Terai	184	277
Nepal	**177**	**229**

ARI = acute respiratory infection
Source: DOHS (2003)

Table 2.20: Distribution of Households by Main Fuel Used for Cooking

Region	Wood (1)	Cow Dung/ Leaves/ Straw (2)	Total Solid Fuel (1+2)	Kerosene	LPG	Other[a] Fuel
Mountain	99.7	0	99.7	0	0	0.3
Hill	76.8	1.3	78.1	6.5	6.5	2.1
Terai	57.0	31.9	88.9	3.6	3.6	2.8
Rural	76.7	17.8	94.5	1.6	1.6	2.0
Urban	30.6	4.8	35.4	19.9	19.9	3.9
Nepal	**69.1**	**15.7**	**84.8**	**4.7**	**8.2**	**2.3**

LPG = liquefied petroleum gas
[a] Other fuels include electricity, biogas, coal or charcoal, and other categories.
Source: NLSS (2004)

Table 2.21: Malnourished Children Below Age 3 (%)

Region	Total	Normal	% Malnourished
Mountain	55,432	45,438	18.0
Hill	384,582	327,316	14.9
Terai	393,948	329,713	16.3
Nepal	**833,962**	**702,467**	**15.8**

Source: DOHS (2003)

Table 2.22: Status and Target of Health -Related Indicators, 2001

Health Indicators	Status	Target
Availability of essential health services (%)	70.0	90.0
Pregnant mother attending four antenatal visits (%)	16.0	50.0
Women of 15–44 age group receivi ng TT vaccines (%)	15.0	50.0
Contraceptive prevalence rate (%)	39.3	47.0
Use of condoms for safe sex (14 –35 years) (%)	35.0	35.0
Total fertility rate (women of 15 –49 years)	4.1	3.5
Crude birth rate per 1,000	34.0	30.0
Birth attendance by trained health workers (%)	12.7	18.0
Newborn infant mortality (per 1,000 live births)	39.0	32.0
Infant mortality (per 1,000 live births)	64.0	45.0
Crude mortality rate (per 1,000)	10.0	7.0
Maternal mortality rate (per 100,000)	415.0	300.0
Child mortality (below 5 years old) per 1,000 live births	91.0	72.0
Life expectancy at birth (years)	61.9	65.0
Total expenditure to total government budget (%)	**5.2**	**6.5**

Source: NPC (2002)

B. Pradhan

Ordinary Dug Well in the Terai Region

B. Pradhan

Improved Dug Well with Protective Cover

protecting the rights of children. Today, this approach has proved to be one of the most successful strategies for the survival of children in many countries.

Diarrheal diseases are a major public health problem among children under five. The National Control of Diarrheal Diseases Programme has been accorded high priority by the government and remains an integral part of primary health care. Improvement in diarrheal case management will be a primary strategy for reducing mortality among children under five years of age. Standard diarrhea case management will be provided in health institutes by establishing oral rehydration therapy corners in all health institutions. The main objective of the National Control of Diarrheal Diseases Program is to reduce mortality due to diarrhea and dehydration from the current 30,000 deaths per year to a minimum and to reduce morbidity from 3.3 episodes per child per year to a minimum.

Rural Sanitation

Rural sanitation refers to access of rural households to drinking water sources, drinking water coverage, types of toilet, and wastewater generation.

Drinking Water

Table 2.23 shows the proportion of households having access to different sources of drinking water for the respective regions as a whole. Most people living in the Mountains and Hills are provided with tap or pipe water, whereas in the Terai tube wells are the main source of drinking water. The national average of access to tap water is 53%. Tap water is said to be safe water. In rural Nepal, most drinking water is provided through public taps. Other water sources such as wells, tube wells, water spouts, and rivers are commonly used by the rural poor.

A Department of Water Supply and Sewerage study in 2002 estimated the drinking water access for the rural population (Table 2.24). By the end of 2007, it is estimated that 92% of the total rural population will be covered with improved drinking water systems provided by different government programs. By 2015, all rural people in the country will have access to a drinking water supply.

Toilet Access

The access of households to toilets in rural and urban areas is shown in Table 2.25. In 2001, the most recent year for which reliable statistics are available, 46% of all households had access to toilets, more in the Hills and less in the Mountains and Terai. Two types of toilet facilities—flush and ordinary (pit)—are identified by the census (CBS 2002b). People using flush or modern toilets are less vulnerable to health risks than those using ordinary toilets. For the country as a whole, only 23% of households had access to modern toilets, and 23% had ordinary toilets. Mountain households had the lowest access (7.9%) to modern toilets. Overall some 40% of rural

Table 2.23: Household Accessibility to Drinking Water by Sources, Nepal

Region	Total Households	Percent of Total Households					
		Tap/ Pipe	Well	Tube Well	Spout Water	River/ Stream	Other
Mountain	285,217	72.2	6.24	0.0	17.1	3.4	1.0
Hill	1,950,345	72.2	11.99	2.4	10.1	2.0	1.2
Terai	1,938,895	30.8	6.48	58.6	1.1	0.6	2.5
Nepal	**4,174,457**	**52.9**	**9.04**	**28.4**	**6.4**	**1.5**	**1.8**

Source: CBS (2002b)

Table 2.24: Existing and Projected Rural Population Drinking Water Coverage

Region	Population 2001	Coverage (%)	Population 2007	Coverage (%)	Population 2015	Coverage (%)
Mountain	1,461,327	77	1,564,008	92	1,717,433	100
Hill	8,360,758	66	9,294,045	89	10,749,057	100
Terai	9,686,970	72	11,316,490	94	13,957,008	100
Nepal	**19,509,055**	**71**	**22,174,543**	**92**	**26,423,498**	**100**

Source: DWSS (2002)

Table 2.25: Toilet Accessibility by Region and Rural–Urban Areas

Region	Total Toilet Households	% Toilet Coverage	Toilet as % of hh		Toilet as % of Rural Toilet hh		Toilet as % of Urban Toilet hh	
			Modern	Ordinary	Total	Ordinary	Total	Ordinary
Mountain	115,157	40.4	7.9	32.5	41.6	82.2	65.4	68.4
Hill	1,088,474	55.8	26.9	28.9	48.4	60.4	87.5	31.3
Terai	722,121	37.3	20.6	16.6	32.6	48.9	64.1	32.1
Nepal	**1,925,752**	**46.1**	**22.7**	**23.4**	**40.3**	**57.6**	**77.1**	**32.1**

hh = households
Source: CBS (2002b)

households had toilets compared with 77% in urban areas. In the Terai region 49% of rural households with a toilet had an ordinary toilet; whereas in the other two regions, the proportion was over 60%. In the Mountain region, 82% of households with a toilet had an ordinary toilet.

Open defecation is common for households that do not have toilets. This is the main source of waterborne diseases. Thus mere curative health facilities such as provision of health service units and other types of facilities will not control common diseases related to poor sanitation. Health program and policy measures should focus on maximizing access to safe drinking water and toilet (sanitation) facilities and increasing awareness of people of the need to use toilets. This will not only minimize expenses on health problems in the long run, but also mitigate the sanitation-related poor environment, which again will curtail the ever-increasing cost of medical care.

Wastewater Generation

Wastewater refers to water that has been used and is no longer clean. Table 2.26 summarizes the wastewater situation in rural and urban areas of Nepal. The total wastewater generation for 2001 has been estimated at 981 thousand cubic meters (m^3) per day for the country as a whole based on Metcalf and Eddy (1999). The wastewater generation per hectare in rural areas is 60 m^3; it is 9 times as high in urban areas (530 m^3). Most of the large cities and towns are in the Hill and Terai regions, and as a result the wastewater generated in the Hills and Terai is much higher than in the mountains. Environmental pollution (rivers, ponds, groundwater, and air) due to increasing wastewater generation is basically an urban problem. Compared with urban areas, the pollution due to wastewater is less significant in rural areas. However, other factors such as open defecation, industries, agri-pests, and fertilizers affect the environment in rural areas.

In urban areas of Nepal, kitchen, laundry, and bath wastewater are normally mixed with toilet wastewater and connected to the drain, which is then directly discharged into the local river. Industrial wastewater is also directly discharged into rivers in most cases. There is no recycling or reuse of wastewater in urban areas[2]. However, reuse of wastewater is made at the individual farmer level. Vegetable farming in Kathmandu Valley is often irrigated by household wastewater. The use of domestic wastewater is a tradition of local farmers. Domestic wastewater is usually accumulated in

Table 2.26: Wastewater (Sewage) Generation ('000m^3)

Region	Wastewater (ww) generation/day	Urban ww/ha	Rural ww/ha
Mountain	68.95	0.15	0.01
Hill	437.89	0.65	0.06
Terai	474.36	0.47	0.12
Nepal	**981.21**	**0.53**	**0.06**

ha = hectare, m^3 = cubic meter, ww = wastewater
Source: Metcalf and Eddy (1999)

[2] A very small portion of the wastewater draining into the Bagmati River from Kathmandu is treated in the middle section at the Pashupati temple area, which is mainly for religious purposes; further downstream wastewater is discharged into the river without treatment.

B. Pradhan

Poor Drainage System in a Terai Village

ponds for some days to allow settling and afterwards used in agriculture. Pollution of rivers by untreated domestic and industrial wastewater has a direct impact on the local environment and health, as the water is used for cleaning vegetables, bathing, washing clothes, and drinking for livestock.

Sanitation System

A sanitation system refers to liquid wastes being connected to underground drains (sewers). Slightly over 12% of households have access to sanitary facilities (drains); but only about 4% of rural households compared with 54% of urban households (Table 2.27). Much of the wastewater is discharged into open drainage systems and is not sanitary. In the Terai, because of the very low gradient, wastewater tends to become stagnant water, providing a good place for mosquito breeding. This is one of the reasons for the increase in vector-borne diseases in the Terai. Sixty-five of the country's 75 districts are malaria-risk districts.

Summary

The policy measures and programs with respect to health and sanitation are described in Chapter 5 on water resources.

Health and sanitation conditions are measured in terms of health indicators such as chronic malnourishment among children under 5 years of age, life expectancy at birth, and population without access to safe water. Rural areas have lower values for these indicators than the national average. The incidence of diseases like intestinal worms, ARI, gastritis, chronic bronchitis, and typhoid that occur due to poor quality drinking water is generally high in Nepal. Compared with the national average, the comparative incidence of diarrheal disease is higher in the Mountains and Hills, whereas the comparative incidence of skin disease is higher in the Terai. ARI due to smoke pollution as a result of poor ventilation is high in rural areas.

Table 2.27: Percentage of Households with Access to Sanitary Facilities (Drains)

Region	% of Households
Mountain	1.0
Hill	18.7
Terai	7.4
Rural	3.7
Urban	54.4
Nepal	**12.1**

Source: NLSS (2004)

Poverty

Rural Poverty

Poverty in Nepal is widespread. Although sources indicate that the level of poverty in Nepal has been rising, the latest estimates indicate that it has now decreased. The poverty survey in 1976 showed that 33% of the population fell below the poverty line and that poverty was most prevalent in rural areas. In 1978, the population below the poverty line was estimated to be 36%, which again increased to 42% in 1985. The 1996 poverty survey (Table 2.28) also showed the national poverty level at 42%, with 25% and 17% being poor and very poor, respectively (NPC 2002). At present, the poverty level is estimated at 31% according to the 2004 NLSS Report.

Poverty in Nepal is largely a rural phenomenon. In 1996, 44% of the rural population lived in poverty compared with 23% in urban areas (Table 2.28). The incidence of poverty was highest in the Mountain regions (56%). There is a wide variation in poverty within rural areas. For example, the poverty rate was highest in the more remote rural areas of the mid-western and far-western Hills and Mountains, where it was as high as 72%. The rural mid-western and far-western Terai regions were also poorer (53%).

Measured in terms of indicators like adult literacy, life expectancy, population without access to safe water, and human poverty index, poverty is more widespread in rural and mountain than in urban areas. The condition of all five selected parameters (Table 2.29) is better in urban areas than in rural areas. Access to safe water, an important indicator of poverty, is better in the Terai than the national average.

Poverty can also be described by its intensity measured in terms of poverty gap and poverty severity related to the total population of the region (Table 2.28). In 1996, the figures for poverty gap and poverty severity were 12% and 5% respectively for the country as a whole. The values for the Terai were lower than the national average, whereas those for

Table 2.28: Income Poverty Indicators in 1996 (Poverty Line: NRs 4 ,404/person/year)

Area	Poverty Incidence % People Living Below Poverty Line	Poverty Gap/ Intensity of Poverty (%)	Sensitivity of Poverty (%)
Mountain	56	18.5	8.2
Hill	41	13.6	6.1
Terai	42	9.9	3.4
Urban	23	7.0	2.8
Rural	44	12.5	5.1
Nepal	**42**	**12.1**	**5.0**

Source: NPC (2002) pp. 14–20.

Table 2.29: Some Indicators of Poverty

Area	Adult Literacy (>15 yrs)	Life Expectancy (yrs) at Birth	Population without Access to Safe Water (%)	Human Poverty Index	HDI (Index = 1)
Nepal	48.6	60.98	20.48	39.6	0.46
Urban	68.3	64.53	11.46	25.2	0.61
Rural	45.0	60.61	22.19	42.0	0.44
Mountain	36.1	52.55	28.01	49.8	0.37
Hill	52.3	65.50	27.70	38.8	0.51
Terai	46.1	63.93	12.10	39.6	0.47

HDI = Human Development Index, yrs = years
Source: UNDP (2004) pp. 141–161.

the Hills and Mountains were higher (14% and 6%) and much higher (19% and 8%). These values suggest that poverty is much worse in the Hills and Mountains than in the Terai. The percentages of poverty gap and poverty severity are greater for rural areas than for urban areas.

Upper social groups like Bahuns, Newars, and Yadavas have much lower poverty levels than lower social groups. In general, the Janajati groups (indigenous ethnics) have higher poverty levels than the national average ranging from 45% to 59%, while the Dalits (scheduled castes) have poverty levels as high as 65%–68% (NPC 2002). The upper caste Chhetris also have an above-average poverty rate at 50%, while Muslims are relatively better off in terms of poverty incidence. The indigenous Limbus have the highest rate of poverty with 71%.

Table 2.30 shows various poverty and human development indicators for different caste and ethnic groups. Compared with the national average, the three upper social groups (Newars, Bahuns, and Chhetris) have better levels of selected poverty indicators (life expectancy, adult literacy, mean years schooling, and per capita income) and human development indices than other groups like the Dalits, Madhise, and Muslims.

The status of some development measures also indicates poverty level. The present national Human Development Index (HDI) value is estimated at 0.471, one of the lowest in the world, although it has increased from 0.403 in 1996. There is a big disparity between urban and rural areas because of differences in availability of human development facilities. The HDI in urban areas is 0.581 compared with 0.452 in rural areas, where most people reside (UNDP 2004). Interestingly, the increase in HDI was less than 3% in urban areas compared with 17% in rural areas during the years 1996–2001. The HDI is lowest in the mountains (0.386), followed by the Terai (0.478) and the Hills (0.512). HDI also varies among the development regions. The HDI value for the Mid-Western and Far-Western development regions is less than the national average.

The Nepal Human Development Report 2004 estimates that the human poverty index for Nepal is 39.6, which is greater than for any of the other South

Table 2.30: Poverty and Human Development by Caste and Ethnicity

Indicator	Nepal		Caste and Ethnicity (1996) [b]						
	2001[a]	1996 [b]	Bahun	Chhetri	Newar	Madhise	Dalit	Muslim	Other
Human Poverty Indicators									
Life Expectancy Years	60.9	55.0	60.8	56.3	62.2	58.4	50.3	48.7	54.4
Adult Literacy (15+) (%)	48.6	36.7	58.0	42.0	54.8	27.5	23.8	22.1	27.6
Mean Years Schooling	2.7	2.3	4.7	2.8	4.4	1.7	1.2	1.4	1.9
Per Capita Income (NRs)	15,162	7,673	9,921	7,744	11,953	6,911	4,940	6,336	73,12
Human Development Indices									
Life Expectancy Index	0.60	0.50	0.597	0.522	0.62	0.55	0.422	0.395	0.49
Education Attainment Index	0.38	0.29	0.490	0.342	0.46	0.22	0.186	0.178	0.22
Income Index	0.43	0.17	0.237	0.181	0.28	0.16	0.11	0.145	0.17
Human Development Index	0.47	0.32	0.441	0.348	0.45	0.31	0.23	0.239	0.29
National HDI Ratio	100	100	135.9	107.3	140.7	96.3	73.6	73.7	90.9

HDI = Human Development Index
Source: [a]UNDP (2004); [b] NPC (2002) (data refer to 1996, the most recent data available for different castes and ethnicities).

Asian countries except Bangladesh and Pakistan (UNDP 2004). The human poverty index in rural areas (42.0) is significantly higher than that in urban areas (25.2). The incidence is most pronounced in the Mountains (49.8), followed by the Terai (39.6) and Hills (38.8).

The human empowerment index (HEI), which is a composite index of social, economic and political indicators, is 0.463 across the country, indicating a low level of empowerment. The level of economic development for the country is 0.337 which is below the social empowerment level of 0.406, while political empowerment stands at 0.646. Among the regions, the Terai has a better HEI value (0.476) than the Hills (0.451) or Mountains (0.359); a higher economic empowerment index (0.392 compared with 0.310 and 0.236); and higher political empowerment index (0.674, compared with 0.568 and 0.526). The economic empowerment index of the Terai is 16% higher than the national average. However, the social empowerment index is highest in the Hills (0.476), followed by the Terai (0.362) and the Mountains (0.315).

The HEI for urban areas is 0.620 compared with 0.439 for rural areas. Urban areas surpass rural areas in all three dimensions of human empowerment. For instance, social empowerment in rural areas (0.372) is just 60% of that in urban areas (0.604). In terms of economic empowerment, the value for rural areas is 0.304, which is about 59% that of urban areas (0.518), due to higher per capita income and better access to economic infrastructure and employment opportunities. The per capita income level in rural areas is less than half the level in urban areas. The rural–urban disparity in political empowerment is less pronounced. The political empowerment score in urban areas (0.737) is only 15% higher than that in rural areas (0.642). The overall HEI value is highest in the central development region (0.497), decreasing in other development regions towards east and west.

Summary

The level and intensity of poverty are closely linked to the pace and pattern of economic growth in urban and rural areas and the income generating opportunities associated with such growth. Rural poverty is worse, primarily because agricultural growth—the primary source of income and employment generation in the rural economy—has stagnated in per capita terms over the past few decades. Even within rural areas, the poorer segments of the population have less access to fertile land, irrigation, modern inputs, credit, and marketing and road infrastructure. Similarly, a key determinant of the level and intensity of both income and human poverty is the limited or nonexistent access to basic social and economic infrastructure. The rural areas are badly underserved in terms of quality and coverage of basic education, healthcare, drinking water, roads, and access to other infrastructure and markets.

Poverty is also closely related to the degree of social, political, and economic inclusion or exclusion. Women and ethnic groups by and large are left out of the mainstream of development because they lack voice, empowerment, representation, and access to economic opportunities and resources. Similarly, remote districts further away from centers of power and influence are the most neglected. Another key determinant, which cuts across and exacerbates the impact of these factors on the poverty pattern, is weak governance, which includes ineffective government, poor resource allocation, weak implementation and service delivery performance, and corruption and leakages, among other factors.

Livelihoods

Major Activities

The living condition of the people of Nepal is determined by the amount and type of resources available and by the ways the resources are utilized. Most people still depend on environmental resources for securing livelihoods. The means of livelihood is generally related to employment opportunities, which are the outcome of investment and development efforts in utilizing the resources. Employment is linked to the process of development. The livelihood of people is reflected through the employment structure and the proportion of people gainfully employed in different economic activities.

It is evident that there was a gradual shift from traditional agriculture to non-agricultural sectors between 1991 and 2001, the most recent year for which reliable statistics are available (Table 2.31).

The agriculture, forestry, and fishery industry is the largest in terms of employment in each region—the Mountains, Hill, and Terai—with the highest proportion (81%) in Mountain areas (Table 2.32).

The major industries are conventionally reclassified into three broad production sectors: primary, secondary, and tertiary. The primary production sector includes agriculture, forestry, and fishery. The secondary sector comprises mining and quarrying and manufacturing and construction. The tertiary sector consists of electricity, gas and water supply; wholesale and retail trade; transport, storage and communication; finance and business services; personal and community services; and others. The latter two sectors combined can also be referred as

Table 2.31: Change in Employment Structure by Major Industries (economically active pop ulation 10 years of age and above)

Industry	1991		2001		Change (%)
	Number	%	Number	%	
Agriculture, forestry, and fishery	5,959,788	81.22	6,504,688	65.70	9.14
Mining and quarrying	2,361	0.03	16,049	0.16	579.75
Production and industry	150,051	2.04	872,252	8.81	481.30
Electricity, gas, and water supply	11,734	0.16	148,217	1.50	1163.14
Construction	35,658	0.49	286,419	2.89	703.24
Hotels, restaurants, and finance	256,012	3.49	984,662	9.95	284.62
Transport, storage, and communications	50,808	0.69	161,637	1.63	218.13
Real estate, renting, and business activities	20,847	0.28	76,687	0.77	267.86
Public administration and social security	752,019	10.25	748,916	7.56	(0.41)
Other	98,302	1.34	100,669	1.02	2.41
Total population	**7,337,580**	**100.0**	**9,900,196**	**100.0**	**34.92**

Source: CBS (2003) Volume I, pp. 341 –371.

Table 2.32: Percentage Distribution of Economically Active Population by Major Industrial Sectors and Region, 2001

Industry	Mountain	Hill	Terai
Agriculture, forestry, and fishery	80.7	68.5	59.8
Mining and quarrying	0.1	0.2	0.2
Manufacturing	5.3	8.1	10.2
Electricity, gas, and water supply	1.3	1.5	1.6
Construction	1.2	2.2	4.0
Commerce	6.2	8.9	11.8
Transport and communication	0.6	1.4	2.1
Finance and business activities	0.2	0.8	0.9
Personal and community services	3.8	6.9	7.0
Others	0.5	1.3	2.2
Not Stated	0.2	0.3	0.2

Source: CBS (2003) Volume I, pp. 341 –371.

Table 2.33: Percentage Distribution of Economically Active Population by Major Industrial Sector for Rural and Urban Areas, 1991 –2001

Sector	1991		2001		Country	
	Rural	Urban	Rural	Urban	1991	2001
Primary	85.5	60.9	72.3	42.2	81.2	65.7
Secondary	1.9	12.4	10.2	18.0	2.6	11.9
Tertiary	11.4	26.1	17.4	39.6	15.0	22.2
Unspecified	1.2	0.6	0.2	0.3	1.2	0.2

Source: CBS (2003) Volume I, pp. 341 –371.

the "non-primary production sector". The primary sector has dominated in terms of employment in both rural and urban areas (Table 2.33). However, the percentage share of primary sector employment decreased in both rural and urban areas from 1991 to 2001.

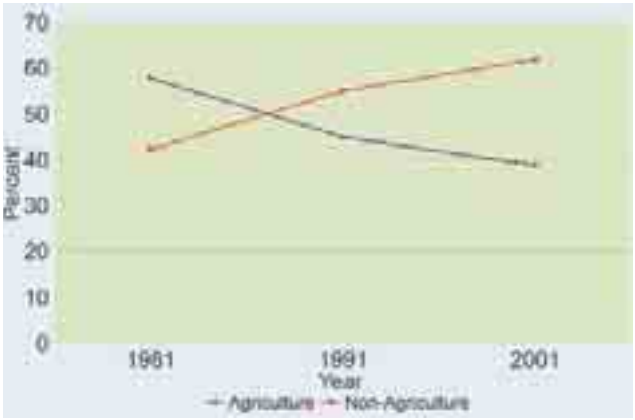
Though the primary production sector's contribution to GDP is less than that of the non-primary production sector (Table 2.34, Figure 2.3), the share of the former (38% in 2001) is still significant. The non-primary sector's contribution increased to 62% of total GDP ($5.6 billion) in 2001 from 54% in 1991.

The primary production sector remains an important source of livelihood for most rural people of Nepal. Table 2.35 shows that 36.5% of all households had agricultural land, livestock, and poultry in 2001; households with only agricultural land and livestock were 29%; and households with only agricultural land were 9%. Households without any of these assets (land, livestock, or poultry) accounted for 19%. The share of agricultural households with all three agricultural assets is largest in Mountain and Hill areas and that of households with land and livestock in Mountain and Terai regions (the most common group overall in the Terai).

Employment and Income Status

Employment source is classified into three major types: wage employment, self-employment, and other (NLSS 2004). Self-employment is the major source of income in Nepal, accounting for 47% of total household income. It is even more dominant in rural areas (50%) and in the Mountains (60%). Income from wage labor is most important in urban areas, accounting for 35%. Wage income and others are the second and third important sources for the country, rural areas, and all three ecological regions; while in urban areas income from other sources is next to wage employment.

Figure 2.3 Contributions by the Primary and Non-primary Production Sectors to National GDP



Source: CBS (2003)

Table 2.34: Contribution to GDP by Sector (%)

Sector	1991	2001
Agriculture, fisheries, and forestry	46.5	37.9
Mining and quarrying	0.5	0.5
Manufacturing	7.0	9.5
Electricity, gas, and water	1.4	1.7
Construction	10.5	9.5
Trade restaurant and hotel	10.7	11.8
Transport and communication	5.7	7.6
Finance and real estate	9.5	10.0
Community and social service	8.3	9.3
Total	**100.0**	**100.0**

GDP = gross domestic product
Source: CBS (2003) Volume I, pp. 341 –371.

Table 2.35: Households Having Agricultural Land, Livestock, and Poultry by Region, 2001

Asset	Mountains		Hills		Terai		Total	
	No.	%	No.	%	No.	%	No.	%
Agricultural land only	17,444	6.12	142,744	7.32	226,053	11.66	386,241	9.25
Livestock only	1,877	0.66	16,010	0.82	104,896	5.41	122,783	2.94
Poultry only	945	0.33	8,024	0.41	15,371	0.79	24,340	0.58
Land and livestock	91,989	32.25	460,488	23.60	636,117	32.82	1,188,594	28.47
Land and poultry	3,517	1.23	23,156	1.19	25,573	1.32	52,246	1.25
Livestock and poultry	2,539	0.89	15,735	0.81	52,278	2.70	70,552	1.69
Land, livestock, and poultry	150,975	52.93	922,689	47.29	453,339	23.39	1,527,003	36.58
None	15,927	5.58	362,345	18.57	424,343	21.90	802,615	19.23
Total	**285,213**	**100.00**	**1,951,191**	**100.00**	**1,937,970**	**100.00**	**4,174,374**	**100.00**

Source: CBS (2002a)

Income[3] sources according to NLSS 2004 include farm income, non-farm income, remittances, consumption of own dwelling (or rent free dwelling), and others (renting out non-agricultural property like buildings or assets, earnings, savings and deposit accounts, shares, pension, and so on). Income from the farm sector accounts for 48% of total household income, followed by the non-farm sector (28%), remittances (11%), consumption of own housing (10%) and others (4%) (Table 2.36). The farm sector is the most important source of household income in all three regions, in rural areas, and in the country as a whole. The Mountain area is the most dependent on the farm sector, followed by the Terai.

There is an increasing trend of income from remittances. The proportion of households receiving remittances from abroad increased from 23% in 1995/96 to 32% in 2003/04. There has been a significant change in the share of remittance amounts by source.

Table 2.36: Share of Household Income by Source (%)

Region	Farm Income	Non-farm Income	Remit-tances	Own Housing Consumption	Other
Mountain	59	19	9	10	3
Hill	45	28	11	12	5
Terai	49	28	12	8	3
Rural	55	23	11	8	3
Urban	13	54	10	17	6
Nepal	**48**	**28**	**11**	**10**	**4**

Source: NLSS (2004) Vol. 2, Table 11.2 .

Eight years ago, the remittance amount from within Nepal and India accounted for 75% of total transfer income. Now, the share of other countries including the Gulf countries accounts for more than half of the total remittance amount (NLSS 2004).

[3] Income was defined as the flow of resources in a household in the past 12 months. The main components considered in the income measure are incomes from crops, non-crop farm, reported valuation of housing consumption of own dwelling, wage employment, non-farm employment, remittances, rental, and other sources.

In 2004, the average annual household income (average household size 5.3) was NRs 80,111, yielding an average annual per capita income of NRs 15,162 (NLSS 2004). The average per capita income in urban areas was NRs 32,573, compared with NRs 12,124 in rural areas; it was higher in the Hills (NRs 18,299) than in the Terai (NRs 12,975) and the Mountains (NRs 12,295).

Landholding Distribution and Land Fragmentation

Landholding distribution and land fragmentation can be related to population growth and distribution. Rapid population growth has increased pressure on agricultural land, resulting in encroachment of marginal lands on fragile hill slopes. This has serious environmental repercussions.

Data on area and fragmentation of landholdings have been derived from the National Census of Agriculture (CBS 2004), the most recent source available. These data on cultivated area are based on national census households; however, they do not match the data derived from mapping sources such as satellite imagery, aerial photographs, and toposheets (which have been used for computing land use categories of the country). According to the agriculture census (CBS 2004), the average landholding size for the country in 2001/02 was 0.79 ha, down from 0.95 ha in 1991/92. The pressure of population on cultivated land has increased considerably. This pressure is even more severe in Hill areas, where the average landholding size is now 0.66 ha (Table 2.37). Households in rural areas have an average agricultural landholding of 0.8 ha compared with 0.5 ha for urban areas.

Average landholdings have decreased, mainly as a result of a decrease in the number of parcels held by a family (CBS 2004 and Table 2.37). The average parcel size and total number of parcels has changed little over the years. Both the average holding size and the average parcel size are largest in the Terai. The average parcel size is smallest, and the number of parcels per holding largest in mountain areas, reflecting the fragmented nature of the landscape.

The distribution of cultivated land is highly skewed. The 2001/02 agriculture census shows that 25% of the total landholdings account for over 61% of the total cultivated land (CBS 2004a). Although the average landholding size was 0.79 ha, nearly 75% of farm holdings were smaller than 0.5 hectare, and accounted for only 39% of all cultivated land. The NLSS shows that 45% of farmers cultivate less than 0.5 ha of land and 8% of farmers cultivate 2 ha or more. Small farmers (less than 0.5ha) cultivate only 13% of all agricultural land as compared with 31% cultivated by large farmers.

Production Pattern

The country's cereal crops are paddy, maize, wheat, millet, and barley. Major cash crops include sugarcane, oilseed, and potato. The area under different crops is shown in Table 2.38. The cropped area is greater than the cultivated area because some areas carry two or even three different crops in a year. Paddy is the principal crop in terms of cropped area, accounting for 45% of the total cropped area of the selected crops in the country.

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Young Women Preparing a Field for Winter Vegetable Crops in Kathmandu Valley

Table 2.37: Area and Fragmentation of Landholdings

Description	Mountain		Hill		Terai		Country	
	1991/92	2001/02	1991/92	2001/02	1991/92	2001/02	1991/92	2001/02
Number of landholdings ('000)	260.7	298.2	1357.7	1,586.4	1117.6	1,479.5	2,736.1	3,364.1
Total area of holdings ('000ha)	176.9	218.7	1047.3	1,038.6	1374.8	1,396.7	2,598.9	2,654.0
Average holding size (ha)	0.68	0.73	0.77	0.66	1.23	0.94	0.95	0.79
Number of parcels ('000)	1207.0		5317.7		4282.0		10,806.2	10,987.0
Average parcels per holding	4.6		3.9		3.9		4.0	3.3
Average parcel size (ha)	0.15		0.21		0.32		0.23	0.24

ha = hectare
Source: CBS (2004) p. 112.

Maize and wheat are the second and third most important crops in terms of cropped area. These three cereal crops have different positions in the different regions. In terms of cropped area, paddy is the most important crop in the Terai (61%); and maize the most important crop in the Hills (38%) and Mountains (29%). Likewise, paddy is the second most important crop in the Hills and wheat in the Mountains and Terai.

Among the cash crops, the Terai has the largest cropped area of oilseeds, and Hill areas the largest cropped area of potato. Sugarcane has the next largest cropped area in the Terai, and oilseed in the Hills. Cropping intensity, measured by the total cropped area divided by the total cultivated area, is greater in the Terai (1.23) than in the Hills (1.11) or Mountains (0.72).

Figure 2.4 shows the trends in cultivated area of cereal and cash crops from 1996 to 2002. The area of major cereal crops changed marginally from 2,942 thousand ha in 1996 to 3,030 thousand ha in 2000 and to 3,010 thousand ha in 2002 (CBS 2004). The cultivated area of the three major cash crops oilseeds, potato, and sugarcane increased consistently from 1996 to 2002.

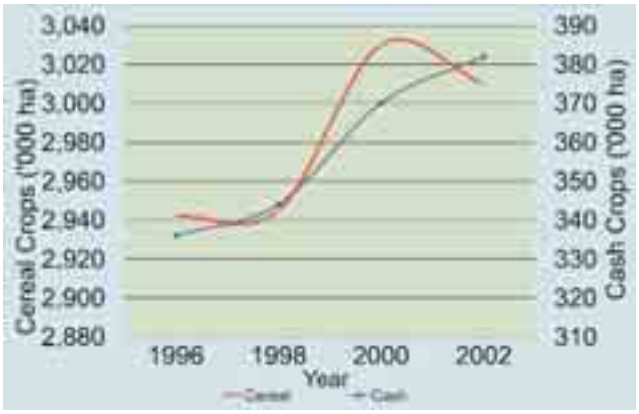
Despite increased production of crops, the country is in food deficit by 41,198 tons (Table 2.39). The Agricultural Perspective Plan estimated that 41 out of 75 districts were food deficient, with the situation in the Mountains in terms of total food requirement the worst. The livelihood groups identified as food deficient are marginal farmers (with landholdings less than 0.5 ha) in all regions; rural service providers; agricultural laborers; potters; and urban squatters. The calorie supply for Nepal is 2448 kilocalories/person/day (FAO 2004). NLSS indicates that 31% of Nepalese households have less than adequate food consumption, and 67% just adequate (CBS 2004a). Food inadequacy is much higher in rural areas (34%) than in urban areas (17%).

Table 2.38: Cultivated Area of Selected Crops by Region (ha)

Crop	Mountain		Hill		Terai		Total	
	ha	%	ha	%	ha	%	ha	%
Paddy	40,430	20.4	396,820	28.2	1,030,000	61.3	1,467,250	44.69
Wheat	42,100	21.3	239,980	17.1	289,180	17.2	571,260	17.40
Maize	57,700	29.2	535,800	38.1	160,590	9.6	754,090	22.97
Millet	25,120	12.7	138,500	9.9	13,020	0.8	176,640	5.38
Barley	10,910	5.5	15,410	1.1	3,340	0.2	29,660	0.90
Sugarcane	100	0.1	2,360	0.2	34,950	2.1	37,410	1.14
Oilseeds	1,840	0.9	28,790	2.0	123,940	7.4	154,570	4.71
Potato	19,550	9.9	47,130	3.4	18,900	1.1	85,580	2.61
Cropped Area	197,750	100.0	1,404,920	100.0	1,680,310	100.0	3,282,980	100.00
Cultivated Area	275,948		1,267,961		1,367,864		2,911,773	
Cropping Intensity	0.72		1.11		1.23		1.13	

ha = hectare
Source: CBS (2001) pp. 86–175.

Figure 2.4: Trends in Cultivated Area of Selected Crops, Nepal (1996-2002)



Source: CBS (2004)

Table 2.39: Food Production and Requirement (tons)

Region	Food Supply	Food Required	Food Balance
Mountain	152,162	277,315	(125,153)
Hill	932,331	1,112,563	(180,202)
Terai	1,843,793	1,579,636	264,157
Country	**2,928,286**	**2,969,514**	**(41,198)**

Source: CBS (2002a)

Mountain areas have the most food inadequate households (35%), followed by the Terai (34%) and Hills (28%).

There is a correlation between the level of food insecurity and the agricultural conditions of farmers in food deficit districts. The problems are most severe in remote mountainous areas where the cropping intensities and crop yields are the lowest, population of livestock per household is the highest, and the opportunities for high-value agricultural production and access to off-farm employment are most limited. The livestock on which these food-insecure people depend most heavily are low yielding due to poor health, resulting in low productivity, and high morbidity and mortality rates (NLSS 2004).

The NLSS indicates that households growing vegetables (both winter and summer) have used the largest amount of improved seeds (33%) followed by onion (18%) and potato (16%). Cereal crops are less important in terms of use of improved seeds. The percentage of agricultural households using improved seeds is less in rural areas than urban areas in all selected crops—paddy, wheat, maize, potato, onion, and vegetables. Paddy growers used the highest percentage (66%) of chemical fertilizer among other agricultural households, followed by wheat (56%), maize (34%), potato (22%), and other crops. Fertilizer use is less among agricultural households in rural areas than in urban areas (NLSS 2004).

Summary

In recent years Nepal's poverty situation has improved significantly at national, rural, and urban levels. However, poverty remains a complex and multidimensional phenomenon. Poverty is deeper, more intense, and more severe in rural areas than in urban areas as measured by parameters like adult literacy, life expectancy, population without access to safe water, and the human poverty index. Likewise, the intensity of poverty measured in terms of poverty gap and poverty severity is greater for rural areas than for urban areas. Poverty is greater among the deprived communities of rural areas.

There is a big disparity between rural and urban areas in terms of human development facilities. The HDI in rural areas is approximately 22% lower than in urban areas and the incidence of poverty 68% higher. The HEI for rural areas is 41% lower than that for urban areas. Urban areas surpass rural areas in terms of social, economic, and political dimensions of human empowerment. The low level of rural economic empowerment is due to limited access to productive assets and lack of gainful employment

B. Pradhan

Farmyard Manure for the Next Crops in the Countryside of Kathmandu

opportunities. The low level of social empowerment of rural areas is due to attributes like poor access to social infrastructure (education, health, and communication media) and income-earning opportunities. As a result of hardship and inaccessibility, and limited access to economic infrastructure, productive assets, and employment outside agriculture, Mountain areas lag behind other regions in all three dimensions of human empowerment and therefore rank among the lowest levels of economic development. The level of political empowerment is relatively better than that of social and economic empowerment, in all areas: rural or urban, and regions. However, the current level of both economic and social empowerment remains far too low to effectively address the overarching goal of poverty reduction on a sustained basis.

Rural households derive their incomes largely from agriculture through self-employment and wage employment, and they are most dependent on the agricultural sector for their livelihoods. This also suggests that opportunities for non-agricultural employment are limited in rural areas. Hill areas provide relatively better opportunities for non-agricultural employment than the Terai or the Mountains, whereas wage agricultural employment is highest in the Terai, indicating that there are significant numbers of marginal farmers or landless poor people in the Terai.

Disparities occur not only between rural and urban areas and among the regions, but also between upper and lower social classes. However, past development efforts have remained largely unsuccessful in attaining equitable and inclusive development of deprived areas and communities into the national mainstream. A major element of the Tenth Plan's poverty reduction strategy is to begin to close this gap as rapidly as possible by mainstreaming deprived communities and regions in the development process. The existing mismatch between socioeconomic and political empower-

ment also indicates a need for more balanced interventions on all three fronts of sustainable empowerment and poverty reduction.

Livelihood security comes from both economic security and environmental security. In the context of Nepal, economic security overall has improved with a decline in the level of those living below the poverty line. However, when the data are disaggregated by region and income groups, it seems that conditions regarding food security might have worsened for some. The conflict situation has worsened Nepal's overall economic situation and environmental status.

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Chapter 3

Land Resources and Land Degradation

Land Resources

Land is a nonrenewable (fixed stock) resource, although it has a renewable capacity to support most forms of biological life. Land, on which activities such as agriculture, forestry, and pasture depend, constitutes about 97% of Nepal's total area. But not all land can be used; the country's topography is rugged with over three-quarters of the total area made up of mountains and inter-mountain valleys. The Terai plain makes up less than one-third of the total area but has the largest cultivated area and population. The Hills, which have traditionally had the bulk of the population, constitute the largest area but are geologically fragile; over time this area's relative share of the population has reduced in favor of the Terai.

Nepal is an agrarian country with over 60% of its economically active population dependent on agriculture, so agricultural and forest lands are very important. Forest covers the largest part of the land area (37%) and is a major source of fuelwood as well as an important factor protecting biodiversity, water, and other watershed resources. The Land Resource Mapping Project (LRMP 1986) and Japan Forest Technology Association (JAFTA 2001) are two of the major sources of forest data, although they are not directly comparable in their classification of land uses and survey techniques. The information for the first source was derived from analysis of aerial photographs together with ground truthing, while the latter was derived from the digital analysis of satellite images. These are the best available sources for data on distribution of land resources by district, and for the purposes of this report, their data were made comparable by generating new broad land-use classifications. Data available at district level have been aggregated into the Mountain, Hill and Terai regions. When interpreting these data, it should be remembered that not only were different methodologies used but also the figures do not differentiate in terms of crown cover or other measures of forest health. For example, even a marked level of deforestation would not be apparent, if crown cover remained above 10%.

The people:land ratio is used to examine the pressure of population on land resources available for cultivation; for 2001 it was 5.7 persons per hectare (pph), compared with 5.6 pph in 1981 (CBS 2003)—an insignificant change during the last two decades. The Mountain zone has the lowest ratio with 3.3 pph, followed by Terai (6.0 pph) and Hill (6.2 pph) zones. The people:land ratio ranges from 1.6 pph for Solukhumbu to 383.7 pph for Dolpa (both mountain districts). However, this is a crude method for assessing the population and land resource relationship. It does not consider the quality of land and the ways land resources are used.

Economic (agricultural) density measures the ratio between the share of total population and the share of total agricultural production by weight. Table 3.1 shows that the economic density (ED) is highest for the Mountains and lowest for the Terai.

ICIMOD file

Secondary Growth Trees

Land Use and Land Cover Change

The distribution of land according to land use types is shown in Table 3.2. Agricultural land is an important resource, it occupied 23.5% of total land uses in 1986 increasing to 28% in 2000. Expansion of agricultural land is a major problem, as it continues to expand to

Table 3.1: Agricultural Economic Density, 2001

Region	Agricultural Production (tons)[a]	Population[b]	Share of Population (SP)	Share of Agricultural Production (SA)	ED = $100\left(\frac{SP}{SA}\right)$
Mountain	597,290	1,687,859	0.073	0.052	140.7
Hill	3,900,035	10,251,111	0.443	0.338	130.9
Terai	7,033,000	11,212,453	0.484	0.610	79.4
Nepal	**11,530,325**	**23,151,423**			

ED = economic density
Source: [a]MOA (2002), [b]CBS (2002)

Table 3.2: Distribution of Land Uses by Region

Land Use Category	1986[a]		2000[b]		Change 1986–2000	
	Area		Area		Area	
	(ha)	(%)	(ha)	(%)	(ha)	(%)
Agriculture	3,461,069	23.52	4,150,979	28.10	689,910	19.93
Forest (including shrub)	6,211,522	42.20	6,788,292	46.12	576,770	9.29
Other	5,045,509	34.28	3,778,829	25.67	(1,266,680)	(25.11)
Nepal	**14,718,100**	**100**	**14,718,100**	**100**		

ha = hectare
Note: To make the LRMP and JAFTA sources comparable, three broad land use categories were obtained. According to the LRMP definition, shrubland has been included in the forest category; no change was made in the agricultural category in either source; and other land uses such as grazing, water bodies, snow, rocky and barren land, and built -up areas have bee n included under the " other" category.
Source: [a]LRMP (1986); [b]JAFTA (2001)

meet the growing demands of the population. Each year, the increasing population is forced to remain in agriculture because of very limited opportunities in non-farm activities.

Table 3.2 shows that total forest coverage including shrub apparently increased between 1986 and 2000, however this may be the result of the different forest survey methods used rather than reflecting a real change (see above). Although more land is being used for agriculture overall, the most fertile lands are being converted to non-agricultural uses for urban areas, industries, road construction, and biodiversity conservation or buffer zone conservation. Large cities are encroaching upon prime agricultural land. This increment could be causing the decrease in the "other" land use category (Table 3.2).

The overall share of agricultural land apparently increased from 24% in 1986 to 28% in 2000 although it declined in the Hills (Table 3.3). The overall per capita agricultural land declined slightly from 0.19 ha to 0.18 ha, but the main decline was in the Hills while in the Mountain region it increased.

The share of forest land apparently increased from 42% in 1986 to 46% in 2000 as a result of increases in the Mountains and Hills; the Terai forest area declined (Table 3.3). The overall per capita forest area declined from 0.34 hectare (ha) in 1986 to 0.29 ha in 2000, although there was a slight increase in the Hill region.

At the national level, both forest and agricultural land resources have increased, which could be due to a decrease in the area devoted to other land uses, but the per capita area of both resources has decreased, mainly because of population growth.

ICIMOD file

Intercropping between Trees

Land Degradation

Land degradation generally refers to loss of utility or potential utility of land or to the reduction, loss, or change of features of land or organisms that cannot be replaced (Barrow 1991). Land is degraded when it suffers a loss of intrinsic qualities or a decline in its capabilities.

Table 3.3: Change in Agricultural and Forest Lands by Region

Region	Agricultural Land (%)		Per Capita Agricultural Land (ha)		Forest Land (%)		Per Capita Forest Land (ha)	
	1986[a]	2000[b]	1986[a]	2000[b]	1986[a]	2000[b]	1986[a]	2000[b]
Mountain	5.33	10.02	0.19	0.31	27.50	31.03	0.99	0.95
Hill	33.37	28.06	0.24	0.17	50.06	62.89	0.36	0.38
Terai	41.57	56.17	0.16	0.17	50.43	38.88	0.20	0.12
Nepal	**23.52**	**28.20**	**0.19**	**0.18**	**42.20**	**46.12**	**0.34**	**0.29**

ha = hectare
Note: The population for de nsity computation of agricultural and forest resources in 1986 and 2000 is based on the 1991 and 2001 population censuses respectively.
Source: [a]LRMP (1986); [b]JAFTA (2001)

Environments and ecosystems are increasingly more controlled or disrupted and degraded by human activities. Landslides, topsoil erosion, siltation, and salinization are different forms of land degradation. Visible forms of land degradation include dust storms, deep gullies, and landslides.

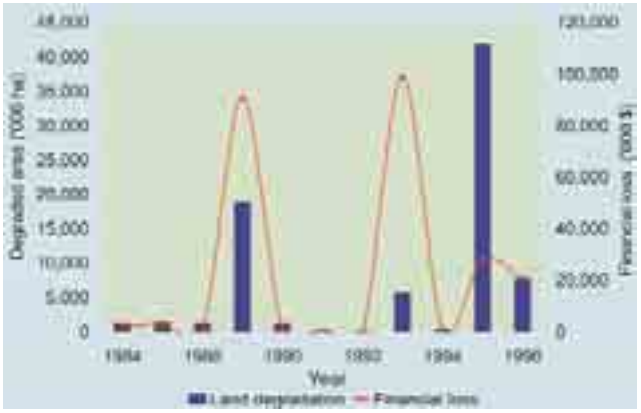
Causes of Land Degradation

The magnitude of land degradation in a place depends on the local geology, land type, landform, land use, rainfall intensity, and human activity. Land degradation results from any causative factor or combination of factors that reduces the physical, chemical, or biological status of land and which may restrict the land's productive capacity. Land degradation is due to (a) natural (biogeophysical) causes, (b) human causes, or (c) a combination of both. Owing to the complex features of the mountain terrain, the nature of land degradation varies greatly in Nepal.

Landslides are the most important factor in land degradation in Nepal. Landslides occur almost every year, particularly in the sloping areas of high mountains and low hills during the monsoon season. The consequences of landslides include topsoil erosion; damaged and destroyed roads, trails, and bridges; loss of land, lives, and property; and siltation in low-lying areas resulting in unproductive land (Figure 3.1). About 1.8 million ha (13%) of the land in the Mountains is estimated to be severely degraded by landslides (CBS 1998).

Table 3.4 provides information on soil erosion rates for different land uses, rock types, and slope levels in the country. The soil erosion rate is higher in the unmanaged land use category and on steep slopes than in the managed land use category. Similarly, intensity of soil loss is found less in cultivated lowlands than in rain-fed sloping terraces, ranging from as low as 7.8 tons/ha/year in the forested Siwalik hills to as much as 570 tons/ha/year in the unforested midhills (CBS 2004). In the middle Hills of Nepal the rate of soil loss in grassland is 0.7-

Figure 3.1: Land Degradation and Financial Loss Due to Floods and Landslides



Source: CBS (1998)

B. Pradhan

Bare Land Exposed to Erosion, Mustang

Table 3.4: Estimated Soil Erosion Rates at Selected Sites in Nepal

Location and Characteristics		Land Use	Erosion Rate (tons/ha/year)
Siwalik Range	Eastern Nepal: south aspect, sandstone foot hills	Forest to grazing	7.8–36.8
	Far West Nepal: south aspect , sandstone, foot hills of Surkhet	Degraded forest	20.0
		Gully land	40.0
		Degraded, heavily grazed gully land	200.0
Middle Mountain	Central Nepal: Mahabharat Lek, steep slope, metamorphic and sedimentary rocks	Degraded forest and agricultural land	31.5–40.0
		Gully land	63.0–420.0
		Degraded forest and shrub land	27.0–45.0
	Kathmandu Valley: northern foothills	Overgrazed shrub land	43.0
		Severe gully land	125.0–570.0
	Kathmandu Valley: south	Dense forest (75%)	8.0
	Pokhara Valley: Phewa Tal wate rshed	Protected pasture	9.2
		Overgrazed grass land	22.0–347.0
		Gully, overgrazed grass land	29.0

ha = hectare
Source: CBS (2004) Table 4.36.

8.7 tons/ha/year, which is less than the 2.5–16.4 tons/ha/year over cultivated terraces. Likewise the rate of land loss in open degraded areas is 25–40 tons/ha/year compared with 3–25 tons/ha/year from cultivated outward sloping terraces (ICIMOD 1998). However, erosion rates in excess of 200 tons/ha/year are common in grazing lands below 1,000 masl where there is overgrazing, which causes gully erosion (Carson 1992).

Owing to weak geological formations such as shallow and coarse lands and loosely compacted rocks, the Churia hills are more vulnerable to rainfall than the mountain areas. As a result, the bare slopes of the Churia hills are readily exposed to degradation every rainy season. The meteorological data show that the Churia hills receive much more intense rainfall than the northern high mountains. Intense soil loss from the Churia hills takes place during the pre-monsoon season when there is less vegetative cover. About 60–80% of all annual soil loss occurs during the pre-monsoon season (DSCWM 1999).

The mountain terrain is rugged and characterized by unstable, steep slopes, making it vulnerable to exogenous factors. The torrential monsoon rainfall that occurs within a short span of time is an important cause of soil erosion. Different forms of mass wasting such as landslides, slumps, rock falls, and river cuttings also contribute to sedimentation in the valleys, plains, and river basins and cause degradation of soil fertility.

The Himalayas (covering 15% of Nepal's area) are also susceptible to land degradation from glacial lake outburst floods (GLOF). Since the second half of the 20th century, the high mountains have been experiencing melting of their large glaciers, resulting in the formation of a large number of glacial lakes behind the unstable "dams" formed from the now exposed end moraines. A slight disturbance can break the balance of the dam, resulting in an abrupt release of a great amount of water and generating floods that can cause serious damage to infrastructure, houses, and the environment downstream. A recent study identified 27 potentially dangerous lakes in the Nepal Himalayas, and found that GLOF events had occurred in 10 of them in past years (Mool et al. 2001). Nepal experienced its most catastrophic glacial lake outburst from the Dig Tsho in 1985.

Anthropogenic activity is equally significant for land degradation. Deforestation, overgrazing, inappropriate use of agro-chemicals, production intensification, shifting cultivation with a shortened cycle, development work, maldistribution of landholdings, industrial waste, and others are all important causes of land degradation.

Glacial Lake Outburst Flood Events

The periodic or occasional release of large amounts of stored water in a catastrophic outburst flood is referred to as a glacial lake outburst flood (GLOF). GLOF events are severe geomorphological hazards and their floodwaters can wreak havoc on all human structures located in their path. Much of the damage created during GLOF events is associated with the large amount of debris that accompanies the floodwaters. Damage to settlements and farmland can take place at very great distances from the outburst source. In Nepal, GLOFs have caused extensive damage to major infrastructure like roads, bridges, trekking trials, and villages, as well as incurring loss of human life (WECS 1996). The government has undertaken some mitigation steps to minimise the risk from one lake by establishing a telemetric early warning system in Tsho Rolpa and lower areas that could be affected. The open canal constructed to lower the lake level of Tsho Rolpa Glacial Lake has been operating since June 2000.

Source: Mool et al. (2001)

Clearing forests for cultivation to meet the food requirements of the growing population, particularly over the sloping areas of the middle Hills, has resulted in accelerated soil erosion, declining productivity, and sedimentation in downstream areas and the Terai plains (Zimsky 1999). Forest resources have also been pressured by increasing numbers of livestock, from 14.9 million head (equivalent to 9,790 thousand livestock units (LU) in 1984 to 17.6 million head (11,226 thousand LU) in 1998. The increasing livestock population has increased the demand for fodder and leaf litter from the forest, causing land erosion especially in the mid Hill region.

Land degradation due to desertification has been seen over about 10,000 ha of dry and cold land in the western Himalayan districts such as Dolpa and Mustang. This is mainly due to scanty vegetation on marginal land grazed by an excessive number of livestock.

Agricultural land is subject to ever-greater intensification of use through double and multiple cropping to produce more food for the increasing population. Soil micronutrients are depleting due to overuse, inadequate supplements, and imbalanced application of fertilizers. For instance, the most recent data available (DOA 2000) show low or medium nitrogen content in 48% and 40% of of 9,827 farmland samples analyzed; 64% of 7,520 farmland samples had low organic matter and high to medium potassium content and 35% had low phosphorous content and overall deficiency in micronutrients such as zinc, manganese, molybdenum, copper, iron, and boron.

These results indicate the highly nutrient deficient status of farmland. As a result, productivity of crops has declined. The impact appears to be much more serious among poor farmers who mostly cultivate marginal lands on steeper slopes. The yields of maize and millet declined by more than 4% per annum between 1977 and 1997, while those of paddy and wheat increased by 16–37% per annum, due mainly to increased use of agro-chemicals (MOA 1999). The use of high yielding seeds has increased the yield of crops per unit of land, but has resulted in less production of crop residues and greater uptake of soil nutrients. This has forced farmers to depend more on fertilizers than on manure, as well as to use different types of insecticides and pesticides. Consumption of fertilizers (nitrogen, phosphate, and potassium) increased from 7 kg/ha per year in 1980 to 25 kg/ha per year in 1993.

Average use of fertilizer by district ranges from less than 10 kg/ha to more than 100 kg/ha. The fertilizer use by Nepalese farmers is lowest among the South Asian countries. The use of pesticides is on the increase. In 1998, the most recent year for which reliable data are available, about 250 types of pesticide, 40 types of herbicide, and various different fungicides were used to minimize the loss of agricultural production to pests and insects (MOF 1999). However, despite the use of pesticides, crop yields have not increased significantly even though the land ecology has been degraded. In commercial farming, the national average consumption rate of pesticides was estimated at 650 g/ha. In 1997, the Pesticides Registration Office at the Department of Agriculture estimated that about 60 tons of different pesticides were imported into Nepal.

Land ownership patterns are another cause of land degradation. The agricultural statistics (CBS 2004) indicate that the marginalized and small farmers with landholdings below one hectare account for 69% of all farmers, but these farms cover only 31% of the total landholding area. As described earlier, there has been an increase in the number of farmland holdings, while the average holding size has decreased.

The land system in and around major urban areas is affected by solid waste disposal. Production of municipal waste increased from 0.144 million tons in 1984 to 0.330 million tons in 1997 (CBS 1998; more recent statistics are not available). Production of toxic and hazardous waste increased from 270 to 512 tons over the same time interval (Tuladhar 1999). This waste is disposed on land surrounding towns or in water bodies without any treatment.

Land degradation is often seen as a side-effect of development work such as construction of roads and irrigation canals along hill slopes, which have contributed to landslides and land erosion. Laban (1979) estimated that 5% of all landslides in Nepal are associated with roads and trails. The construction of roads is on the rise, and after roads are built they are usually ravaged by recurrent landslides and rock falls during the monsoon season.

Stone quarrying can also lead to landslides and soil erosion; however, no hard data are available.

Impacts of Land Degradation

One of the direct impacts of land degradation is the loss of topsoil, which together with organic matter and plant nutrients influences soil fertility. Loss of soil at the rate of 5 tons/ha is equivalent to a loss of 75 kg/ha of organic matter, 3.8 kg/ha of nitrogen, 10 kg/ha of potassium, and 5 kg/ha of phosphorous in the middle hills of Nepal (Carson 1992). The country's major rivers carry away thousands of tons of sediment annually, but a large part of this occurs naturally and a significant part is composed of riverbed load, embankment erosion, and similar components.

Impacts of land degradation like landslides and land erosion are the most pressing problems in Nepal. These occur every year during the rainy season. While landslides and land erosion mostly occur in the Hills and Mountains, floods occur in the valleys and the Terai plains. Floods wash away land or deposit debris, but in some situations flooding adds alluvium which is good for soil fertility.

The loss of life and property as a result of floods and other natural disasters is discussed below.

Land Degradation Control Measures

Land degradation is an important factor hindering agricultural production in Nepal. Government measures to conserve the land resource and its proper planning and development include establishing the Department of Soil Conservation and Watershed Management in 1974, and formulation of the Soil and Watershed Conservation Act (1982) and its Regulations (1985) to protect watersheds. But these legal instruments are very restrictive and therefore have not been implemented. At present DSCWM is introducing a process to amend these laws.

B. Pradhan

Human Pressure on Land—Terraced Fields used for Crops

Community forestry has been a successful policy initiative in controlling land degradation. Its aims are to manage forest resources and use of forest products by involving local communities. According to the Department of Forest, by February 2000 more than 650,000 ha of public forests had been given to local forest user groups to be managed as community forests. Local control of community-managed forests has led to increases in productivity and biomass because of strict protection from fires, free grazing, and uncontrolled cutting. These protection activities have encouraged natural regeneration of forest cover and helped stabilize gentle slopes. Because of the increased forest cover, the water regime (both yield and quality) has improved at the micro-watershed level (Mathema et al. 1998).

The Agricultural Perspective Plan has identified fertilizer input as a major contributing factor to accelerating agricultural growth. The Ninth Plan (NPC 1999) recognized that there is now a need to have sound land management programs to maintain land quality and fertility. The Plan also envisaged formulation of a Fertilizer Act and the establishment of a Fertilizer Unit at the Ministry of Agriculture, though these have not yet come to pass.

Nepal has signed various international conventions and treaties related to conservation of land. The UN Convention to Combat Desertification (June 1994) was signed by Nepal on October 12, 1995, and obliges Nepal to combat desertification and to prepare a national action plan including programs for poverty reduction, which is closely related to land degradation.

Natural Disasters and Vulnerability

Physical changes are a part of nature, and humans have learned to cope with these changes quite well. However, time and again these events turn very violent and then tragedy strikes resulting in huge suffering and loss of lives and assets. If the Himalayas are a part of these natural events, the floods in the southern plains are also an integral part of this cycle of change.

As human activities increase significantly even in environmentally sensitive areas, people become vulnerable to all sorts of natural events. What yesterday was seen as a normal natural event is today poised to be a natural disaster because of the impact on humans as steep slopes and flood plains are settled, as heavy construction is undertaken in highly seismic zones without adequate safeguards, and as natural systems are altered by construction, pollution, and excessive harvesting of resources.

Clearly natural processes will not stop or alter to suit human needs, although many “natural” changes are also now understood to be anthropogenic. We have only one planet and our survival depends on all the life support systems being able to function adequately. Natural events are an integral part of this process, and it is humans who should change their behavior and make the necessary adaptations. The challenge for poor countries like Nepal is to develop the capability first to understand the ongoing changes and then to be able to alter activities as needed both in the short and long term.

Tables 3.5 and 3.6 show examples of losses of lives and property by type of disaster and year. In

Table 3.5: Loss of Lives and Property by Different Types of Disasters in Nepal in 2002

Type of Disaster	People			Affected Families	Livestock Loss	Houses Destroyed	Cattle Shed Destroyed	Estimated Loss (NRs '000)
	Deaths	Missing	Injured					
Floods and Landslides	441	21	265	39,309	2,024	18,181	775	418,915
Fire	11	0	6	1,387	100	1,604	37	94,739
Epidemics	0	0		0		0	0	0
Windstorm	3	0		227		70	45	4,847
Hailstorm	0	0		0		0	0	7,000
Lightning	3	0	16	12	2	1	0	63
Earthquake	0	0		0		0	0	0
Total	**458**	**21**	**287**	**40,935**	**2,126**	**19,856**	**857**	**525,564**

Source: CBS (2004) Tables 5.19–5.20.

Table 3.6: Disaster Casualties 1995 -2002

Year	People		Livestock Loss	Homes Destroyed	Affected Families	Land Affected (ha)	Estimated Loss (million NRs)
	Deaths	Injured					
1995	873	1,937	2,053	10,275	134,210	41,870	1,933
1996	895	1,523	2,480	30,014	58,320	6,060	1,579
1997	1,160	1,120	1,191	4,825	46,050	6,060	410
1998	1,190	117	1,179	15,082	36,980	320	1,230
1999	1,466	146	65	4,304	17,840	180	509
2000	377	162	1,017	6,886	24,900	880	1,141
2001	415	132	665	6,103	15,900	—	526
2002	458	287	2,126	19,856	40,930	10,070	525

— = not available, ha = hectare
Source: CBS (2004) Tables 5.19–5.20.

2002, 458 deaths were attributed to different natural calamities with financial losses amounting to some $7 million (Table 3.5). The impacts are greater when people have no opportunity to choose alternative livelihoods or dwelling sites. In two earlier episodes in 1984 and 1993, 363 and 1,336 deaths of people were caused by landslides and floods and financial losses were incurred amounting to $1.9 million and $99.1 million (DPTC 1997).

Nepal is highly vulnerable to droughts, floods, earthquakes, landslides, forest fires, storms and hailstorms, avalanches, glacial lake outburst floods, and the effects of global warming. Of the 75 districts in the country, 49 are prone to floods and/or landslides, 23 to fire, and one to wind storms. A total of 64 out of 75 districts are prone to disasters of some type according to the Department of Narcotics and Disaster Management. Many of these natural disasters cannot be stopped. However, to minimize the human and other losses that are incurred, better understanding of traditional coping mechanisms and their modification to suit present reality has become an urgent necessity at the local, district, and national levels. The threats to very costly infrastructure are very real and every known precaution is necessary. Even the practice of environmental impact assessment is quite recent and has a long way to go. Settlement and building guidelines should be properly developed and enforced to improve preparedness against earthquakes and floods. There is still no close monitoring of the different natural disasters, and without a proper understanding responses will be limited in scope and content.

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Chapter 4

Forestry and Biodiversity

Forestry

Forest Resources and Their Use

The forest in Nepal is defined as all lands having trees with more than 10% crown cover (DFRS 1999). Covering 37% of the country's total area (JAFTA 2000), the forest is, Nepal's largest natural resource. Forest types range from sub-tropical hardwood to softwood. The forest has three important functions: production of goods (firewood, fodder, timber, and herbs), protection of the natural environment, and regulation of atmospheric conditions. Forest production enhances the economy of the community, while the protection and regulation functions are concerned with ecological conservation.

The forest is the principal source of fuelwood. According to the Ministry of Finance (MOF 2003, p. 70, Table 10.1), energy consumption in Nepal is excessively dependent on fuelwood, which represents 75% of the total fuel consumption (8,416 thousand tons of oil equivalent). In rural areas wood consumption exceeds 94% of the total fuel consumption, compared with 39% in urban areas (see Table 2.5). Terai forests provide most of this fuelwood since they are easily accessible. Excessive use of fuelwood, particularly in rural areas, is due to lack of alternative energy sources. For instance, only 2.3% of rural households use kerosene compared with 36% of urban households.

The forest is also used as grazing land for livestock. The livestock population including cattle, pigs, goats, and sheep reached 17.6 million head (11,226 livestock units) in 1998 from 14.9 million head (9,790 livestock units) in 1985, while the grazing area (1,757,000 hectares [ha]) has remained more or less constant over the last 20 years (UNEP 2001). The increased numbers of livestock mainly depend on forest for grazing.

Finally, the forest area has been used for infrastructural development such as roads, schools, public places, institutional buildings, human settlements, and so on. More than 120,000 ha of forest have been cleared for infrastructure development (DFRS 1999).

Change and Distribution of Forest Areas

According to the most recent survey, based on satellite imagery (JAFTA 2001), the country now has 37% forest coverage and 9% shrub area, making up a total of 46% (Table 4.1). The percentage of total area covered by forest and shrub is highest in the Hills (50% and 13%), followed for forest by the Terai and the Mountains. The Hills have 57% of the total forest resources in the country.

D. Joshi

Deforestation

Table 4.1: Distribution of Forest Resources by Region, 2000

Region	Area (ha)	Forest		Shrub		Total Forest Resources	
		Area (ha)	% of region	Area (ha)	% of region	Area (ha)	% of country
Mountain	5,181,700	1,181,631	22.8	426,363	8.2	1,607,994	23.7
Hill	6,134,500	3,085,885	50.3	771,842	12.6	3,857,727	56.8
Terai	3,401,900	1,237,545	36.4	85,026	2.5	1,322,571	19.5
Nepal	**14,718,100**	**5,505,061**	**37.4**	**1,283,231**	**8.7**	**6,788,292**	**100**

ha = hectare
Source: JAFTA (2001)

The trend of forest coverage in the country is shown in Table 4.2. The table shows the finding of the different surveys regarding overall forest resources in Nepal. However, comparisons of the findings from the different sources are difficult as the definitions and methodologies used are not directly comparable (see discussion in Chapter 3) . This creates serious problems for any comparative analysis of the changing nature of forest resources in Nepal.

ICIMOD file

Community Forest

Table 4.2: Change in Forest and Shrub Cover (%)

Forest Resources	1986[a]	1994[b]	2000[c]
Forest	37.4	29.0	37.4
Shrub	4.8	10.6	8.7
Total	**42.2**	**39.6**	**46.1**

Source: [a] LRMP (1986); [b] DFRS (1999); [c] JAFTA (2001)

Table 4.3: Proportion of Forest Area by Region (ha)

Region	Forest Area per 100 ha (1994)[a]	Per Capita Forest Area (1994)[a]	Forest Area per 100 ha (2000)[b]	Per Capita Forest Area (2000)[b]
Mountain	2.3	0.08	22.8	0.70
Hill	39.68	0.29	50.3	0.30
Terai	35.17	0.14	36.4	0.11
Total	**29.00**	**0.23**	**37.4**	**0.24**

ha = hectare
Source: [a]DFRS (1999) cited in UNEP (2001), p.63. [b] JAFTA (2001)

Table 4.3 shows the change in forest coverage by area and person in the three regions between 1994 and 2000; there are no consistent patterns in forest, regional forest endowments, or per capita availability. The table suggests that there may be marked differences in the definition or recognition of "forest" in mountain disticts between the two surveys.

Factors of Forest Change and Impacts

Forest surveys carried out from 1986 to 1994 provide information on forest area change and its causes, while the Japan Forest Technology Association (JAFTA 2001) forest survey only indicates the change in forest area. The following analysis looks at the causes of change between 1986 and 1994 (Table 4.2), as there are no data for analysis of the subsequent trends.

Forest depletion refers to the diminishing of forests in quantity and quality. Quantity refers to the gross area covered by the forest whereas quality signifies the density of trees in the forest area. Between 1986 and 1994, the total forest area decreased considerably. The loss can be attributed to (i) uncontrolled use of forest products, (ii) increasing pressure of livestock, (iii) transboundary smuggling of logs, and (iv) inappropriately designed forest policies.

Most rural people (83%) depend on forest fuelwood for cooking, because alternative energy sources for cooking and heating are limited in rural areas. Consumption of fuelwood alone constituted 94% of the total energy output. The fuel consumption for household and industrial biomass was estimated to be 15.4 million tons in 2000 compared with 11.3 million tons in 1985. Per capita annual fuelwood consumption in the Hills is estimated to be 640 kilogram (kg) compared with 479 kg in the Terai. The timber demand at national level was projected to be about 2.5 million cubic meters (m^3) by 2000. Rapid population growth, which has remained at over 2% per year since 1961, is considered to be the most important factor behind diminishing forest resources in Nepal. In the Terai, migration is a major factor in forest encroachment. There are several reasons for dwindling Terai forests.

Between 1986 and 1991, 99,400 ha of Terai forests were cleared (CBS 1998), much of which was converted into cultivated area. During the early 1990s, many of the forest areas of Jhapa and Morang districts in eastern Nepal were encroached upon by the Bhutanese refugee camps.

A Finnish International Development Agency study (FINNIDA 1993) showed a decline in the growing stock of sal (*Shorea robusta*) forest from 101 to 72 m^3/ha and from 76 to 58 m^3/ha for other Terai hardwood forests. The Nepal Australia Community Forestry Project indicated that the thinning of forest in the upper slopes of the Hills was due to over cutting of fuelwood and lopping trees for fodder (Tamrakar 1996).

Degradation of Terai forest all along the Indo-Nepal border is mainly due to transboundary smuggling of logs into India. This activity intensified with the increase in price of logs in India (Rajbhandari 1997).

Some of the government forest policies, such as the Private Forests Nationalisation Act 1957 and the Land Tax Act of 1977, were unfavorable for conserving forest resources. These policies instead allowed local people uncontrolled access to both public and private forests in their areas (Perdo 1993; Shah 1997).

Forest depletion has direct impacts on local environmental degradation. The average annual deforestation rate of 1.7% is high considering Nepal's fragile hill ecosystem. Wyatt-Smith (1982) and Shepherd (1985) estimated that 3 ha of forest would be required to sustain 1 ha of agricultural land or each person would require about 1.65 ha of forest for the country as a whole. The diminishing forest area has further burdened rural women, who are responsible for collecting firewood and fodder and fetching drinking water, besides other household chores. They have little time for other productive activities (Zimsky 1999). Forest depletion contributes to environmental degradation such as landslides, soil erosion, floods, soil depletion, loss of biodiversity, reduction in water flow from upstream areas, and increasing siltation of water bodies in low-lying areas.

Conservation of forest resources is fundamental for stabilizing the systems that help sustain all types of ecological processes essential for human existence and wellbeing. Alternative livelihood activities should be made available to rural people to reduce their dependence on forest resources. In addition, effective public awareness programs about forest conservation and its importance need to be initiated through different communication media and school curricula. Research needs to be carried out for designing effective public awareness programs.

Development Efforts in Forest Conservation and Management

The Government has introduced different programs for conserving and managing forest resources. One effort is the community forestry program initiated in 1978, which has emphasized sustainable management and development of forests through communities' involvement as forest user groups. By 1999, the Government had handed over a total of about 0.7 million ha of state-owned forests to over 10,532 community forestry user groups for development, conservation, management, and sustainable use. A total of six million people had directly benefited from being members of user groups by 2000. Leasehold forest management through user groups is another program. In 1993, 270 ha of state-managed forest was handed over to user groups for leasehold forestry, and this increased to over 6,550 ha in 2000.

Some forest areas have been declared protected areas such as national parks, wildlife reserves, and conservation areas. The coverage of protected areas increased from 0.976 million ha in 1984 to 2.476 million ha in 1998. The Alternative Energy Promotion Center was created to develop programs for providing alternative energy resources and technology to reduce dependency on traditional energy sources such as fuelwood. This center, in collaboration with INGOs and the private sector, has initiated biogas plants to replace fuelwood for cooking and lighting, thereby helping to conserve forests. The number of biogas plants has increased from about 200 in 1975 to 90,000 in 2002 in 66 districts of the country (ENPHO/MOPE 2002). Likewise, the improved cooking stove program has been designed to increase the efficiency of firewood use and to reduce smoke. Over 90,000 improved stoves of various types are being distributed throughout the country (ENPHO/MOPE 2002).

Forest conservation and development in Nepal has been promoted through different Government acts and legislation since 1957. Some of these are listed below. Nepal has also signed various international conventions and treaties related to the conservation of forests and biodiversity.

(i) Acts

(a) Private Forests Nationalisation Act 1957
(b) Forestry Act 1963
(c) Forest Protection (Special Arrangements) Act 1967
(d) Soil and Watershed Conservation Act 1982
(e) National Parks and Wildlife Conservation Act 1973 and Amendment (NPWC) 1993
(f) Forest Act 1993 and Amendment 1999
(g) Forest Regulations 1995
(h) Environment Protection Act 1996

(ii) Policies and Strategies

(a) National Forestry Plan 1976
(b) National Conservation Strategy 1988
(c) Forestry Sector Policy 1989
(d) Nepal Environmental Policy and Action Plan 1993
(e) Master Plan for the Forestry Sector 1989–2010
(f) Policy Document: Environmental Assessment in the Road Sector of Nepal 2000
(g) Nepal Biodiversity Strategy 2002

(iii) Regulations and Guidelines

(a) Environmental Impact Assessment Guidelines for the Forestry Sector 1995
(b) Buffer Zone Regulations 1996
(c) Environment Protection Regulations 1997

Biodiversity

State of Biodiversity

Nepal's great variation in topography—altitudes ranging from 60 to 8,848 meters above sea level (masl) over a small distance of 190 km from south to north—has resulted in a great diversity of climate and vegetation ranging from subtropical to cold desert. Nepal has been endowed with a rich variety of plants and animals. The different biological species play a role not only in establishing symbiotic relationships among themselves but also have great economic value. People's relationship with their surroundings has changed over time, affecting the biodiversity of the landscape.

With an area of only 0.1% of the global surface area (147,181 km^2), Nepal hosts some of the most spectacular natural areas in the world. Nepal possesses over 2% of the world's flowering plants, about 9% of the world's bird species, and about 4% of the world's mammalian species (see Appendix 4.2). In terms of species richness, Nepal is in 11th position in Asia and 25th position at the global level.

"Ecosystem" refers to a unit that includes all organisms (populations, communities, habitats, and environments) in a given area interacting with all components of the physical environment. Nepal has 118 types of forest ecosystems spread over four physiographic regions (Table 4.4), 181 species of mammals, 844 species of birds, 185 species of fish, 143 species of reptiles and amphibians, over 5,884 species of flowering plants, and about 2,287 species of fungus and lichens (CBS 2003) (see Appendices 4.1 and 4.2).

Table 4.4: Ecosystems in Protected Areas

Zone	Number of Ecosystems	Ecosystems in PAs
Terai	10	10
Siwalik	13	5
Middle Hill	52	33
Highland	38	30
Others	5	2
Total	**118**	**80**

PA = protected area
Source: CBS (2003)

Over 400 species of agro-horticultural crops have been reported in Nepal including 200 species of vegetables (NAA 1995). Of these, around 50 species have been domesticated for commercial and household consumption. Fifteen fruits with more than 100 varieties, 50 vegetables with 200 varieties, and 10 varieties of potatoes are cultivated commercially. Some wild genotypes have also been identified and domesticated by local people because of their economic value.

Sixteen protected areas (together with six Buffer Zones) have been established for the protection of flora and fauna (Figure 4.1). These protected areas are in the form of national parks (9), conservation areas (3), wildlife reserves (3), and a hunting reserve (1) and are intended to provide protection to diverse species of plants and animals in climates ranging from sub-tropical to cold desert. The protected areas make up about 17% of the country's total area. Of these, the Sagarmatha National Park and the Royal Chitwan National Park have been included in the World Natural Heritage List; and the Koshi Tappu Wildlife Reserve, Bishajari Tal (Chitwan), Jagdishpur Jalasha Reservoir (Kapilbastu), and Ghodaghodi Tal (Kailali) have been designated as Ramsar sites.

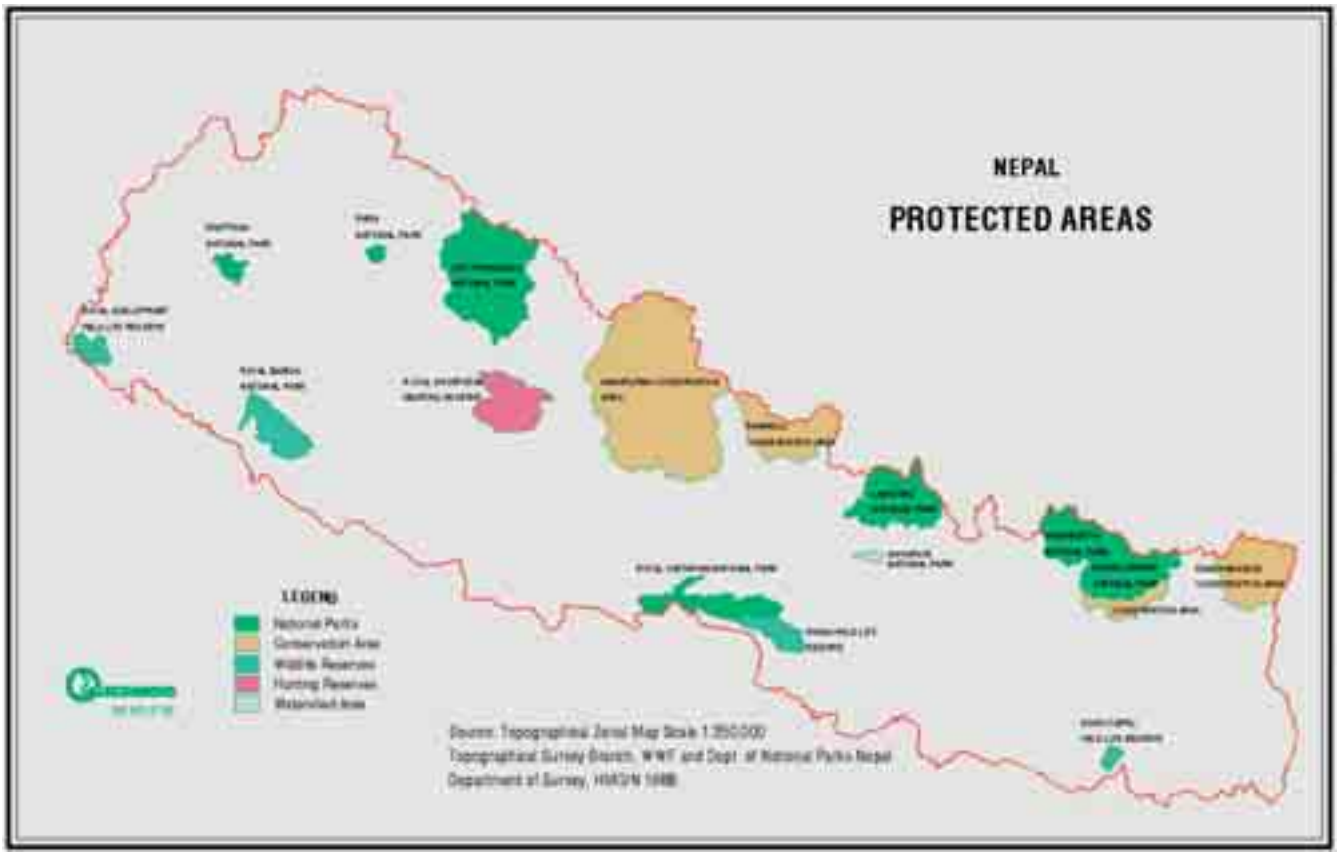
Factors Diminishing Biodiversity

Wildlife and biodiversity are an important natural resource in Nepal, as well as an indicator of environmental quality. Loss of wildlife and biodiversity means degeneration of environments such as forest and water bodies. Any human or other intervention can cause environmental imbalance, with unfavorable implications for these natural ecosystems. The preservation of these unique ecosystems and the sustainable use of products obtained from them remains an environmental challenge for the country.

Forests are the most important natural ecosystem in Nepal. Much of the former forest area has been converted to cultivated land, built up area, roads and other infrastructure-related uses. Deforestation has a significant impact on flora and fauna. Nepal's threatened animal species constitute 3.8% of the world's threatened mammals and 2.3% of birds (CBS 2003). Clearing and burning forests, draining and filling wetlands, converting natural ecosystems into agricultural land, and meeting the demand for fuelwood, fodder, litter, medicinal plants, and animals for meat and other requirements has resulted in a huge loss of biodiversity.

Habitats have suffered due to loss, alteration, over-extraction or illegal collection of species, poaching or hunting of wild animals, over-grazing, fire, and commercial trade. The economic value of endangered or rare species in the world market is very high. Illegal trade of wildlife products such as rhino horn, tiger skin and bone, ivory, fur, and antlers is a serious problem in and around protected areas. In two decades, the country lost 76 rhinos due to poaching (DNPWC 2001). Likewise, the populations of musk deer, red panda, bears, and many other species have declined in the mountains (Shrestha and Joshi 1996). Due to increased pressure on their

Figure 4.1: Protected Areas in Nepal



ICIMOD

IUCN

Russell's Viper (*Vipera russelli*)

IUCN

Rhododendron Dalhusiae

usage, many species of plants, butterflies, fish, insects, birds, and mammals have been listed as threatened, vulnerable, or rare (Shrestha and Joshi 1996; Suwal et al. 1995). Out of 32 rare plant species listed, 8 are already extinct (CBS 2003).

Efforts Towards Biodiversity Conservation

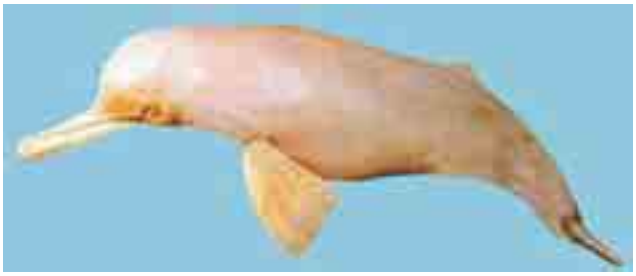
The Government has established the Department of National Parks and Wildlife Conservation and created a network of protected areas. After creation of the protected area network, there has been an increasing trend in the population of wild animals. The rhino population increased from 60 in the late 1960s to 612 in 2000, the last year for which reliable statistics are available (DNPWC 2000). Similarly, a continued conservation effort in protected areas has improved the habitat and increased the number of wildlife such as endangered tiger, musk deer, and many other species (DNPWC 2000). Translocation and reintroduction of some species has reduced the risks of loss of these animals from being in only one area. However, species outside protected areas are still under great pressure. Wildlife species such as greater one-horned rhinoceros (*Rhinoceros unicornis*) have been translocated from one park to another to set up other viable populations.

The Government has given legal protection status to 13 plants, 26 mammals, 9 birds, and 3 reptile species. Almost all these faunal species and about 20 plant species are included in the CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) appendices.

Different alternative energy sources to replace or reduce fuelwood use such as back-boilers, kerosene depots, small hydropower plants, solar water heaters, and space heaters have been introduced in Mountain areas (such as Annapurna Conservation Area Project [ACAP] and Sagarmatha areas); and biogas, electricity, kerosene, improved cooking stoves, and solar power in the Terai. Studies show that these have reduced fuelwood consumption and thereby increased conservation of forests (DNPWC 1999; Lama and Lipp 1994; Wells and Brandon 1992).

IUCN

Long-Billed Vulture (*Gyps indicus*)



IUCN

Freshwater Gangetic Dolphin (*Platanista gangetica*)

IUCN

Wetland area

The Government has formulated acts and regulations to safeguard the biodiversity of the country. Some of these have been listed above. The National Planning Commission in collaboration with The World Conservation Union (IUCN) is to implement a national conservation strategy, which has biodiversity conservation as a key component. In 1993, these two organizations developed the Nepal Environmental Policy and Action Plan. This plan identified four priority actions for biodiversity conservation. In addition, Nepal has signed different international conventions such as the Ramsar Wetland Convention, World Heritage Convention, and CITES to show its commitment to the conservation of biodiversity.

A buffer zone approach has been implemented around the borders of the Royal Chitwan National Park, Royal Bardia National Park, Langtang National Park, Sheyphoksundo National Park, Makalu Barun National Park, and Sagarmatha National Park to solve park-people conflicts and protect park animals, as well as to ease the biotic pressure on core areas and to promote sustainable management of natural resources. This conciliatory approach is aimed at motivating local communities to undertake participatory management of forest resources through user groups. This program refunds 50% of the total revenue of protected areas, which the communities can use for their socioeconomic betterment. This provision has demonstrated the direct benefit of protected areas as a long-term measure for conservation of biodiversity resources through government-community partnership.

Wetlands like rivers, lakes, reservoirs, village ponds, paddy fields, and marshlands are rich in biodiversity and different indigenous communities often have cultural attachments to them (Table 4.5). Wetlands cover some 5% (743,500 ha) of the land area of the country (MOFSC 2003). There are a total of 242 designated wetlands: 163 in the Terai and the remainder in the Hill and Mountain regions.

Nepal's wetlands are home to 193 of 841 recorded bird species. Terai wetlands alone have 187 bird species, of which 180 are found in the Koshi Tappu Wildlife Reserve. In addition to birds, wetlands are home to a number of fish species, reptiles, and amphibians. Other wild animals such as rhinoceros (*Rhinoceros unicornis*), wild buffalo (*Bubalus bubalis*), swamp deer (*Cervus duvaucelli*), Gangetic dolphin (*Platanista gangetica*), and otter (*Lutra lutra*) also depend on wetlands. Wetlands are probably the last refuges of some wild relatives of

Table 4.5: Wetland Types in Nepal

Wetland Type	Estimated Area (ha)	Percent of Total
Rivers	395,000	53.12
Lakes	5,000	0.67
Reservoirs	1,380	0.19
Village ponds	5,183	0.70
Paddy fields	325,000	43.71
Marshland	12,000	1.61
Total	**743,563**	**100.00**

ha = hectare
Source: MOFSC (2003)

cultivated plants, and also have significant value for fishing, irrigation, and religious and recreational (boating, rafting) use. Many indigenous communities depend on wetland resources for their survival. Accordingly, Nepal has sought to conserve the wetland ecosystem and ensure the participation of local communities for sustainable use of its components (MOFSC 2003). This policy recognizes wetlands management as an essential component of an ecosystem approach to natural resource management and has identified participatory wetlands management, classified wetlands from a management perspective, and developed other components of sustainable development.

Ecotourism development is an integral part of the protected area system in Nepal. The prime objective of ecotourism has been to promote a symbiotic relationship between tourism and the environment, with a particular focus on uplifting the local host economy. This concept is also applied in village communities sited in and around protected areas.

Through ecotourism, tourists get opportunities to observe and learn. Its potential contribution to cultural conservation and long-term sustainability of communities and natural resources is huge. Ecotourism is considered a form of sustainable tourism that benefits the community, environment, and local economy. This may be achieved through various means such as employment for local people or programs in which tourists contribute money to community activities. In Nepal, the ACAP provides one of the best examples of ecotourism. Under this project, several village sites have been identified for community-based ecotourism development.

The ACAP, covering an area of 7,629 km^2 in the western Himalayan region, covers one of the three conservation areas of Nepal. ACAP was created in 1986 under the King Mahendra Trust for Nature Conservation and gazetted as a Conservation Area in 1992. The main aim of ACAP is to balance natural resource conservation and sustainable community development. The area is characterized by both biodiversity and cultural diversity. ACAP has been successful in gradually changing traditional subsistence activities into a framework of sound resource management, supplemented by conservation, development of alternative energy programs (such as micro hydroelectricity, biogas plants, solar power, kerosene depots, and fuelwood saving technology) to minimize the negative impacts of tourism and to enhance the living standards of local people. It follows the principles of maximum people's participation, sustainability, and a catalytic role. The focus in Jomsom, Manang, and Ghandruk, which are popular trekking areas, is on integrated tourism management and agro-pastoralism, where local communities are involved in tourism-based income generating activities.

The Annapurna Conservation Area has been a prime destination for trekkers ever since it was opened to visitors. Of Nepal's total 100,828 trekkers in 2001, 65% visited the Annapurna area. ACAP is authorized to collect entry fees from visitors, and the revenue from trekking has been used to create an endowment fund with the objective of achieving financial self-sustainability. The fund is used for natural resource conservation and community development, which has brought positive results to the livelihoods of the people of the Annapurna area. An understanding of conservation and the sustainable use of natural resources has proved to be a crucial catalyst for sustaining development. ACAP has since become a model for conservation and development not only for other parts of the country but also for the rest of the world. Many national parks and protected areas in Nepal have either adopted or refined the ACAP model (ACAP 2002).

Summary

The forest is the most important natural resource, and the most important natural ecosystem, in Nepal. Forests are the principal source of fuelwood and fodder, and are also used for grazing and building of roads, public buildings, and other infrastructure. Any change—decrease or increase—in the forests can affect wildlife, biodiversity and water sources, all of which depend upon forests. Analysis of forest resources in Nepal has been based on different sources and methods. These sources and methods have shown a change in forest coverage—a decrease from 1986 to 1994 followed by an increase up to 2000, but the surveys used different methodologies and techniques and it is difficult to draw any firm conclusions. Anecdotal evidence and local observations show that depletion of forest area is most common in areas with relatively better

IUCN

Elizabeth Kerkhoff

Different ways of maintaining biodiversity: in protected areas (Shey Phoksundo National Park, top) and through indigenous agroforestry practices (shifting agriculture field, bottom)

access for people, as the majority of rural people still use forests as sources of fuelwood and fodder. A very critical issue that has emerged is that of the lack of comparability of forest data. Unless comparable data is made available that covers all aspects of forest resources, it will be very difficult to design appropriate interventions for the different regions.

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Appendix 4.1: Forests and Other Ecosystems by Region

Region	Major Ecosystems		
	Number	Sub-region	Ecosystem Type
Terai	10 + 3 = 13	Upper Tropical Eastern Region	Tropical riverine forest Sal (*Shorea robusta*) forest
		Lower Tropical Western Region	Terai tropical sal forest (*Shorea robusta, Terminalia tomento sa*, ...) Khair-sossoo (Acacia - Dalbergia) riverine forest *Samalia malabarica, Trewia nudiflora* - riverine forest Bhabar light sal forest Pseudo steppe with Gramineae (tropical elephant grasses)
		Lower Tropical Eastern Region	Terai tropical sal forest Tropical mixed wet forest Tropical dense forest with *Terminalia sps*.
		Other	Cultivated areas Terai cultivated areas Water bodies
Siwaliks	13 + 1 = 14	Upper Sub-tropical Western Region	Upper Siwalik chir pine-oak forest
		Upper and Lower Sub-tropical Western Region	Siwaliks chir-pine forest *Alnus nitida* riverine forest
		Upper Tropical Western Region	Tropical hill sal forest in large valleys Troical riverine forest (*Albizzia lebbek*, *Toona ciliata* ..) Sal forest in inner valleys (*Shore robusta*, *Terminalia tomentosa*), Mesophytic tropical forest on southern slopes of the Siwaliks Hygrophytic tropical forest on northern slopes of the Siwaliks Siwalik tropical deciduous forest
		Upper Tropical Eastern Region	Tropical hill sal forest Dense forest with *Shorea robusta*, *Lagerstroemia parviflora* .... Dense forest with *Terminalia tomentosa*, *T. belerica* ...
		Lower Tropical Level Western Region	Dun valleys sal forest
		Other	Dun cultivated areas
Middle Hills	52 + 2 = 54	Montane Western Region	Mesophytic montane oak-rhododendron forest Mixed blue pine-oak forest Mixed hygrophytic oak-hemlock-fir forest Open and dry montane blue pine forest Blue pine-spruce forest Juniper forest (*Juniperus indica*) Rhododendron-hemlock-oak forest Hemlock forest (*Tsuga dumosa*) Mountain oak forest (*Quercus semecarpifolia*) Blue pine-spruce-fir forest Spruce mountain forest (*Picea smithiana*)
		Montane Eastern Region	*Lithocarpus pachyphylla* forest Rhododendron forest Deciduous mixed broad-leaved forest Mixed broad-leaved forest (*rhododendron-acer-symplocus-lauraceae*) *Daphniphyllum himalayense* forest with a few *Rhododendron grande*
		Collinean Western Region	Blue pine-cypress forest Cypress forest with dwarf barberry Collinean oak forest (*Quercus leucotrichophora*, *Q. lanata*) Mixed blue pine-oak forest Mixed oaks-laurels forest with shrubs Mixed hygrophytic broadleaved forest with oaks Cedar forest (*Cedrus deodara*) Open blue pine forest (*Pinus wallichiana*) Collinean oak-mixed broadleaved forest (*Quercus lanata*) Aesculus, Juglans riverine forest Deciduous broadleaved forest (Alnus, Juglans, Acer)

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Appendix 4.1: Table continued

Region	Major Ecosystems		
	Number	**Sub-region**	**Ecosystem Type**
Middle Hills (cont.)		Collinean Central Region	Hygrophytic Quercus lamellosa forest
		Collinean Eastern Region	Hygrophile forest with *Quercus lamellose* Hygrophile forest with *Castanopsis tribuloides* Mesohygrophile forest with *Quercus glauca* Mesohygrophile forest with *Quercus lanata* and *Pinus excelsa*
		Sub-Tropical Eastern Region	*Eugenia tetragona* , *Ostodes paniculata* forest
		Upper Sub-tropical Western Region	Mixed chir pine - oak forest (*Pinus roxburghii* , *Quercus leucotrichophora*) *Quercus glauca* , *Alnus nepalensis* , *Betula alnoides* riverine forest Open *Olea cuspidata* forest Sub-tropical mixed broadleaved forest *Quercus incana* and *Schima wallichii* forest
		Upper Sub-tropical Central Region	Hygrophytic *Schima wallichii* , *Castanopsis tribuloides* forest
		Upper Sub-tropical Eastern Region	*Castanopis tribuloides* forest with *Schima wallichii* .. *Castanopsis hystrix* forest with *C. tribuloides* .. *Alnus nepalensis* forest
		Upper and Lower Sub - tropical Western Region	Chir-pine forest with grasses and Engelhardria Mixed chir pine broadleaved forest *Alnus nepalensis* riverine forest Euphorbia royleana steppe in inner valleys Grasses - *Artemesia* steppe
		Upper and Lower Sub - tropical Central Region	Hygrophytic *Schima wallichii* forest
		Upper and Lower Sub - tropical Eastern Region	*Schima wallichii* , *Castanopsis indica* hygrophile forest *Schima wallichii* , *Pinus roxburghii* mesohygrophile forest *Pinus roxburghii* xerophile forest with *Phyllanthus emblica* *Schima wallichii* , *Lagerstroemia parviflora* hygrophile forest
		Other	Pokhara cultivated areas Water bodies
Mountains	38 + 1 = 19	Nival level	Glaciers, snow, rock
		Upper Alpine Level	Alpine meadow with Gramineae and Cyperacea Xerophytic mat patches , scarcely vegetated rocks , and scree Mesophytic mat patches , scarcely vegetated rocks , and scree Mesophytic and hydrophytic mat patches and scarcely vegetated rocks Alpine meadows on the southern side of the Himalaya s Dry alpine vegetati on on the northern side of the Himalayas High altitude discontinuous vegetation cushion plants Meadows and mat patches Scarcely vegetated rocks and scree of upper alpine level Meadows and land communities
		Lower Alpine Level	Rhododendron mesohygrophyti c scrublands -Juniperus ... meadows Rhododendron mesohygrophytic scrublands (*R. anthopogon* , *R. nivale* ...) Juniper mesohygrophytic scrublands (*J. indica, R. recurva, J. squamata*) Xerophytic closed alpine mat and scrub Mesophytic closed alpine mat and scrub Shrub lands with patches of abundant *Rhododendron anthopogon, R. nivale*
		Upper Sub-Alpine Level Western Region	Mesophytic closed sub -alpine mat and scrub (*R. anthopogon*) Rhododendron-birch forest (*Betula utilis, R. campanulatum*) Birch-blue pine open fore st
		Upper Sub-Alpine Level Central Region	North Himalayan alpine vegetation

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Appendix 4.1: Table continued

Region	Major Ecosystems		
	Number	**Sub-region**	**Ecosystem Type**
Mountains (cont.)		Upper Sub-Alpine Level Eastern Region	*Betula utilis* forest with rhododendron and *Abies spectabilis* Rhododendron shrub lands Rhododendron-juniper shrub lands
		Lower Sub-Alpine Level Western Region	Mesophytic fir forest with oak and rhododendron Hygrophytic fir-hemlock-oak forest Fir forest (*Abies spectabilis*)
		Lower Sub-Alpine Eastern Region	*Abies spectabilis* forest with rhododendron *Larix griffithiana* forest *Larix griffithiana* and *L. potanini* forest *Larix potanini* forest
		Steppic Formations - North West Region	High altitude cushion plant formation *Caragana vericolor* and *Lonicera spinosa* steppe *Caragana gerardiana* and *Lonicera spinosa* xerophytic steppe *Caragana brevispina* and *Artemisia* steppe *Caragana pygmaea* and *Lonicera spinosa* xerophytic steppe Myricaria-Hippophae-Salix riverine thickets *Sophora moorcroftiana* and *Oxytropis mollis* steppe
		Other	Water bodies
Total	**118**		

Source: BPP (1995)

Appendix 4.2: Protected Plant and Wildlife Species

Table A4.2.1: Protected Plant Species and Forest Products (Pursuant to Section 70 (kha) of the Forest Act 1993)

Scientific Name	Local Name	Family	Status	
			IUCN	CITES
Plants banned for collection, use, sale, distribution, transportation and export				
Dactylorhiza hatagirea	Panch ounle	Orchidaceae		II
Juglans regia (only bark)	Okhar	Juglandaceae		
Picrorhiza scrophulariiflora [a]	Kutki	Scrophulariaceae		
Plants banned for export except processed in the country and permission issued from DOF along with th e recommendation of DPR or HPPCL				
Abies spectabilis	Talis patra	Pinaceae		
Cinnamomum glaucescens	Sugandakokila	Lauraceae		
Lichens spp.	Jhyau			
Nardostachys grandiflora	Jatamansi	Valerianaceae		
Rauvolfia serpentina	Sarpaganda harbaruwa	Apocynaceae	V E	II
Taxus baccata subsp. Wallichiana	Loth salla	Valerianaceae		
Valerianna jatamansi	Sugandabala	Valerianaceae		II
Forest products banned for export except processed in the country through boiling and extraction method and permission issued from DO F along with the recommendation of DPR or HPPCL				
Asphaltum (rock exudate)	Silajit			
Ban on export except processed in the country through steaming and packaging, and permission issued from DOF along with the recommendation of DPR or HPPCL				
Cordyceps si nensis	Yarcha gumba	Clavicipitaceae		
Timber trees banned for felling, transportation, and export for commercial purposes				
Acacia catechu	Khayer	Leguminosae		
Bombax ceiba	Simal	Bombacaceae	T	
Dalbergia latifolia	Satis sal	Fabaceae		
Juglans regia (only from national forests)	Okhar	Juglandaceae		
Michelia champaka M. kisopa	Chanp	Magnoliaceae		
Pterocarpus marsupium	Bijaya sal	Fabaceae	E	
Shorea robusta	Sal	Dipterocarpaceae		

CITES = Convention on International Trade of Endangered Species of Wild F auna and Fl ora; DOF = Department of Forest ; DPR = Department of Plant Resources; HPPCL = Herbs Production and Processing Company Limited ; IUCN = The World Conservation Union, Ex = extinct, E = endang ered, T = threatened , V = vulnerable;
Notes: CITES Appen dix I = Species threatened with extinction; Appendix II = Species not yet threatened but which could become endangered if trade is not controlled; Appendix III = Species that are protected by individual countries within their borders and for which cooperat ion of other convention signatories is sought.
[a] Species to be specified and recommended for export by DPR, and availability to be considered by DoF before issuing license for export.
Source: His Majesty's Government of Nepal (2001)

Table A4.2.2: Status of Protected Wildlife under the National Parks and Wildlife Conservation Act 1973

Scientific Name	Local Name	Common Name	Status	
Mammals			**IUCN**	**CITES**
Ailurus fulgens	Habrey	Red panda	V	I
Antilope cervicapra	Krishna sagar	Black buck	V	III
Bos gaurus	Gauri gai	Gaur bison	V	I
Bos mutus	Yak/Nak	Wild yak	E	I
Bubalus arnee	Arna	Wild water buffalo	E	III
Canis lupus	Bwanso	Grey wolf	V	I
Caprolagus hispidus	Hispid kharayo	Hispid hare	E	I
Cervus duvauceli	Barasinghe	Swamp deer	E	I
Elephas maximus	Hatti	Asiatic elephant	E	I
Felis lynx	Pahan biraloo	Lynx	E	II
Hyaena hyaena	Hundar	Striped hyaena	E	
Macaca assamensis	Assamese rato bander	Asamese red monkey		
Manis crassicaudata	Salak	Indian pangolin		II
Manis pentadactyla	Salak	Chinese pangolin		II
Moschus chrysogaster	Kasturi	Himalayan forest musk deer	E	I
Ovis ammon	Nayan	Great Tibetan sheep		I
Panthera tigris	Bagh	Bengal tiger	E	I
Panthera uncia	Hiun chituwa	Snow leopard	E	I
Pantholops hodgsoni	Chiru	Tibetan antelope		I
Pardofelis nebulosa	Dhwanse chituwa	Clouded leopard	V	I
Platanista gangetica	Souns	Gangetic dolphin	V	I
Prionailurus bengalensis	Chari bagh	Leopard cat		I
Prionodon pardicolor	Silu	Spotted lingsang		I
Rhinoceros unicornis	Gainda	Asian one-horned rhinoceros	E	I
Sus salvanius	Sano (Pudke) bandel	Pigmy hog	Ex (?)	I
Tetracerus quadricornis	Chauka	Four-horned antelope	V	III
Ursus arctos	Himali rato bhalu	Brown bear		I
Birds				
Buceros bicornis	Raj dhanesh	Great-horned hornbill		I
Catreus wallichii	Cheer	Cheer pheasant	E	I
Ciconia ciconia	Seto saras	White stork		
Ciconia nigra	Kalo saras	Black stork		II
Eupodotis bengalensis	Khar mujur	Bengal florican	E	I
Grus grus (G. antigone)	Saras	Common crane		II
Lophophorus impejanus	Danfe	Impeyan pheasant		I
Sypheotides indica	Sano khar mujur	Lessor florican	E	II
Tragopan satyra	Monal	Crimson-horned pheasant		III
Reptiles				
Gavialis gangeticus	Ghadial gohi	Gharial	E	I
Python molurus	Azingar	Asiatic rock python	V	I
Varanus flavescens	Sun gohoro	Golden monitor lizard	I	I

CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora; IUCN = The World Conservation Union, V = vulnerable, E = endangered, Ex = extinct

Notes: CITES Appendix I = Species threatened with extinction; Appendix II = Species not yet threatened but which could become endangered if trade is not controlled; Appendix III = Species that are protected by individual countries within their borders and for which cooperation of other convention signatories is sought.

Source: MOFSC (2002)

Table A4.2.3: Nepal's Share in Plant Species in the World

Groups	Nepal		World Species[c]	Nepal's Share (%)
	Species[a]	Endemic species[b]		
Nonflowering plants				
Algae	687	3	26,000	1.7
Fungi	1,822	16	69,000	2.6
Lichen	465	39	20,000	2.7
Bryophytes	853	30	16,600	6.1
Pteridophytes	380	8	11,300	3.2
Non-flowering total	**4,207**			**2.7**
Flowering plants total	**5,884**	**246**	**220,529**	**2.4**

Source: [a]CBS (2003); [b]MOFSC (2002); [c]Wilson (1988; 1992)

Table A4.2.4: Nepal's Share in Animal Diversity in the World

Groups	Nepal		World Species[c]	Nepal's Share (%)
	Species[a]	Endemic species[b]		
Arthropods				
Insects	5,052	5	1,000,000	0.44
Butterflies and Moths	2,893	30	112,000	2.6
Spiders	144	108	73,400	0.2
Freshwater fishes	185	8	18,150	0.1
Herpetofauna				
Amphibians	43	9	4,184	1.0
Reptiles	100	2	6,300	1.6
Birds	844	2	9,040	9.3
Mammals	181	1	4,000	4.5

Source: [a]CBS (2003), [B]MOFSC (2002); [c]Wilson (1988; 1992)

Chapter 5

Water Resources

Introduction

Water is the most plentiful natural resource in Nepal. The major sources of water are glaciers, rivers, rainfall, lakes, ponds, and groundwater. Of these, rivers are the largest source in terms of water volume and potential development. There are over 6,000 rivers in the country with an estimated total length of 45,000 kilometers (km) (DHM 1998). All large rivers are fed by snowmelt from the Himalayas and hence they are a renewable water resource. The country has 660 lakes of more than 1 hectare (ha). Big lakes are used for irrigation, hydropower generation, fishing, and others. About 75% of the total annual rainfall (average 1,700 mm) falls during the summer monsoon season (June–September) during which major agricultural activities take place. Groundwater remains an important source of water, particularly in the Terai region and Kathmandu Valley.

Surface Water Discharge

Surface water is the major source of drinking water in Nepal (WECS 2004). The major rivers of Nepal are the Koshi, the Gandaki, the Karnali, and the Mahakali, all of which originate in the Himalayas. Table 5. 1 shows the catchment area and discharge of selected major rivers. The Koshi river basin is the largest, covering a catchment area of 60,400 km^2, of which 46% lies in Nepal and the remainder in Tibet Autonomous Region of the People's Republic of China. It has an average runoff equivalent to 1,409 cubic meters per second (m^3/sec) at Chatara. Some 23% of Nepal's population live in this river basin. The Gandaki river basin in the central region includes about 90% of the river's total catchment area. The Karnali and the Mahakali river basins lie in the west of Nepal. Some 22% of Nepal's population live in the Karnali basin, which has a population density of 92 persons per km^2. The Mahakali River acts as the border between Nepal and India. About 34% of its catchment area lies in Nepal.

The Babai, Bagmati, Kamala, Kankai, and West Rapti are medium-sized rivers originating from the Mahabharat range. These rivers, like the Himalayan rivers, are perennial. The innumerable southern rivers originating from the Siwalik hill range are shallow and mostly dry up during the dry season. These rivers are used by the managed irrigation schemes of small-scale farmers for seasonal supplementary irrigation. They often swell and overflow due to monsoon rains, destroying land and lives. The forests once covering most of the Siwalik hills have become degraded (Chapter 4). Every year flooding affects the Siwalik land including the forests. A study by The World Conservation Union (IUCN 2000) indicates that due to forest degradation, surface runoff rates have increased in areas exposed

Table 5.1: Water Discharge of Rivers, Nepal

River Basin	Catchment Area (km^2, estimated)		Average Discharge (m^3/s)	Annual Discharge (billion m^3/year)
	Total	in Nepal		
1. Himalayan rivers				
Koshi	60,400	27,863	1,409	45.0
Gandaki	34,960	31,464	1,600	50.0
Karnali	43,679	41,058	1,397	44.0
Mahakali	15,260	5,188	573	18.0
2. Mahabharat rivers		17,000	461	14.5
3. Siwalik rivers		23,150	1,682	53.0
Total		**145,723**	**7,122**	**224.5**

km^2 = square kilometer, m^3/s = cubic meters per second, m^3/year = cubic meters per year
Source: WECS (2004)

to intense weathering, and percolation rates have decreased. The Siwalik watershed areas are now impoverished and water recharge into the soil has been reduced. During the rainy season, the heavy rainfall coupled with the soft rock results in maximum sediment loads to rivers and streams. A decline in the level of the groundwater table has been reported, and desertification has begun in the Terai due to deforestation in the Siwalik range. In the Siwalik area of eastern Nepal, forest coverage declined by nearly 13% between 1979 and 1999, and 68 ha of land was damaged as a result of landslides (IUCN 2000).

Use of Water Resources

Table 5.2 shows the water availability and use by sectors in 1995 and 2001. The country has about 224 km^3 of annual renewable water, and the annual per capita water supply in 2001 was 9,600 m^3, down from 11,000 m^3 in 1995 (DHM 2001). In 1995, the total annual withdrawal of water for consumptive uses (domestic, agriculture, and industry) was 14 km^3 and per capita annual withdrawal of water was 690 m^3. Although the total annual withdrawal of water increased in 2001, most of the increase went to agriculture, while the percentage used for domestic purposes decreased (UNEP 2001). Agriculture used about 96% of the total withdrawal in 2001, mostly for irrigation, with the domestic sector's share less than 4%. The use of water by the industrial sector is insignificant. The estimated total annual water requirement for irrigation in the cultivated area is 67 km^3, which makes up nearly 30% of the total water potential of 224 km^3.

Current annual withdrawal of groundwater is about 0.756 km^3 for irrigation and 0.297 km^3 for domestic uses (WECS 2004). Groundwater is the best alternative source of water supply, particularly in the Terai region and Kathmandu Valley. The total ground water potential of the country is 12 km^3, of which 5.8 to 11.5 km^3 can be extracted annually without any adverse effects. However, the level of groundwater in Kathmandu Valley is already dropping due to overexploitation, as described in the next section. The Bhabar zone with dense forest cover, a contiguous area of the Terai, is the recharge area for the Terai's groundwater.

In addition to these uses, river water is also used for generating hydropower. The country has 83,000 megawatts of potential hydropower generation, of which 42,000 megawatts are economically viable. At present, total electricity generation is around 559 megawatts (WECS 2004). Further, microhydropower plants are operated in several parts of the Hill and the Mountain regions, although their contribution to total hydropower generation remains small at 1.2%. Local streams and rivulets are also important sources of energy for agro-processing in the Hill and Mountain regions. Operation of water mills (ghattas) for grinding grain has existed for centuries; it is environmentally sound though not very economically profitable. There are about 25,000 water mills in Nepal (MOPE/REDP 2002).

Table 5.2: Water Availability and Use by Sectors, Nepal

Description		1995[a]	2001[b]
Total annual renewable water resource (km^3/year)		224.0	224.0
Per capita renewable water resource ('000 m^3/year)		11.0	9.6
Total annual withdrawal (km ^{3}/year)		14.0	18.5
Per capita annual withdrawal (' 000 m^3/year)		0.69	0.8
Withdrawal (percent)	Domestic	3.8	3.6
	Industry	0.3	0.3
	Agriculture	95.9	96.1

km^3/year = cubic kilometers per year, m^3/year = cubic meters per year
Note: 1 billion m^3 = 1 km^3.
Source: [a]UNEP (2001); [b]WECS (2004)

Sources, Quantity, and Quality of Drinking Water

The quantity and quality of water directly and indirectly affect human activity, health, and sanitation. These in turn depend on the water sources. Normally a person requires two liters of water per day for basic physiological processes (WHO 1996). Water quality refers to the suitability of water to sustain living organisms. For humans, it is used for drinking, bathing, washing, irrigation, and industry. Changes in water quality are reflected in its physical, biological, and chemical conditions, and these in turn are influenced by natural and anthropogenic activities.

Sources of Drinking Water

Nepal is a mountainous country with diverse physiographic regions, and thus different sources of drinking water are available for people in different areas (Table 5.3). Tap water is the most important source, providing drinking water to almost 53% of all households. Tap water refers to water piped directly from a source as well as to centrally distributed and pretreated water. The second most important source is tube wells. These two sources are important in both urban and rural areas. The relative share of tap water in urban and rural areas is 65% and 51%, respectively, followed by tube wells with 23% and

Table 5.3: Type of Water Sources Used by Households

Drinking Water Source	Total Households		% of Total U/R hh		% of Total M/H/T Households (hh)		
	Number	%	Urban	Rural	Mountain	Hill	Terai
Tap water	2,209,760	52.9	65.4	50.6	72.2	72.2	30.8
Tube well	1,184,156	28.4	23.1	29.4	0.0	2.4	58.6
Well	377,241	9.0	5.9	9.6	6.2	12.0	6.5
Stone spout	267,180	6.4	3.3	7.0	17.1	10.1	1.1
River	61,400	1.5	0.5	1.7	3.4	2.0	0.6
Other	74,721	1.8	1.8	1.8	1.0	1.2	2.5
Households	**4,174,457**	**100.0**	**664,505**	**3,509,952**	**285,217**	**1,950,345**	**1,938,895**

hh = households , M/H/T = Mountain, Hill, or Terai, U/R hh = urban or rural households
Source: CBS (2002) Table 1.

Table 5.4: Household Access to Drinking Water Sources (%)

Region	Piped to House	Piped Outside of House	Covered Well	Open Well	Other	Total
Mountain	10.5	61.8	1.2	2.5	24.1	100
Hill	23.5	46.3	4.1	4.6	21.5	100
Terai	6.2	8.5	74.6	5.1	5.6	100
Rural	6.7	32.5	39.6	4.9	16.2	100
Urban	53.3	14.3	25.3	3.4	3.9	100
Nepal	**14.4**	**29.5**	**37.2**	**4.7**	**14.2**	**100**

Source: NLSS (2004)

29%. While tap water is the dominant source in the Mountains and Hills, tube wells dominate in the Terai. All the sources of water listed in Table 5.3 are used by some households in all three regions, except tube wells which are not available in the Mountains.

Access to Drinking Water Supply

According to the latest survey (NLSS 2004), the share of households with access to piped water in 1995/96 was 32%, which increased to 53% in 2003/04 (Table 5.4). The latter consists of households with water piped to the house (14%) and households with piped water outside of the house (30%). About 39% of all rural households have access to piped water compared with 68% in urban areas. Access to piped water is lowest in the Terai; 75% of Terai households have access to covered wells (tube well), whereas 62% of the households in the Mountains have access to piped water outside the house (community tap). Other water sources include rivers, streams, and ponds.

Water Quantity

Table 5.5 summarizes the water supply and demand condition within and outside Kathmandu Valley, as well as water treatment and leakage problems in general. The share of total production capacity of drinking water in the region outside Kathmandu Valley increased from 31% in 1999 to 42% in 2001. The relative demand and average daily production of water show a similar situation. The Valley's water tap connections constitute slightly over three fifths compared with two fifths of the outside valley area, but the relative share of the latter increased between 1999 and 2001. Treated water represents about 50% (NWSC 2001).

To date, about 72% of the country's total drinking water demand has been met (NPC 2002). Access to safe drinking water in rural areas has increased compared with that in urban areas due to the relative decrease in rural population growth compared with urban population growth. Each year the drinking water demand grows, and as a result, pressure on the existing output of water is intense. Over the last few decades, the population has grown at a rate of over 2% per annum. The area of agricultural land has also increased, demanding additional irrigation water. Natural factors such as landslides and floods have also put pressure on water resources by damaging reservoirs and irrigation canals.

The pressure on drinking water sources is intense in large cities due to rapid urbanization. For example, most of the surface water sources in Kathmandu Valley have been tapped for water

Table 5.5: Water Supply and Water Treatment Plant s

Description	1999	2001
Production capacity million liters per day (mld)	182	228
Inside Kathmandu Valley (%)	68.7	57.9
Outside Kathmandu Valley (%)	31.3	42.1
Water demand (mld)	214	275
Inside Kathma ndu Valley (%)	74.77	64.36
Outside Kathmandu Valley (%)	25.23	35.64
Average daily production (mld)	155	204
Inside Kathmandu Valley (%)	67.74	54.90
Outside Kathmandu Valley (%)	32.26	45.10
Total tap connections	162,254	188,250
Inside Kathmandu Val ley (%)	65.77	60.45
Outside Kathmandu Valley (%)	34.23	39.55
Water leakage (waste) (%)	38	37
Population served by NWSC in 28 municipalities	1,638,000	1,825,000
Number of drinking water treatment plants	13	15
Total water treatment (mld)	90	100
Total water treatment (%)	58.1	49

mld = million liters per day, NWSC = Nepal Water Supply Corporation
Source: NWSC (2001)

Table 5.6: Water Quality of Major Rivers During Dry Season

Sample Sites of Major Rivers in Different Parts of Nepal	pH	TDS (mg/l)	DO (mg/l)	BOD (mg/l)
Mahakali at Pancheswar, far west	8.8	110.0	5.0	<2
Karnali at Chisapani, far west	8.9	264.0	10.5	1.5
Bheri at Chatgaon, mid west	7.8	208.0	9.3	1.1
Seti at Ramghat, west	8.2	2.2	9.3	<2.5
Rapti at Sauraha, centre	7.8	213.0	8.7	—
Arun, east	6.5	200.0	—	—
Kankai, east	7.7	60.0	—	—
Mechi, east	8.3	30.0	—	—
WHO Guidelines	6.5-8.5	100.0	>5.0	3.0

— = not available , mg/l = milligram per liter, BOD = biological oxygen demand, DO = dissolved oxygen, TDS = total dissolved solid s, WHO = World Health Organization
Source: CBS (1998)

Figure 5.1: Water Quality Change in the Bagmati River, Kathmandu Valley

Source: UNEP (2000)

supply, and much of the groundwater is being used. The groundwater level in the Valley is lowering due to excessive use for drinking purposes. The total sustainable withdrawal of groundwater from the Valley's aquifers is approximately 26.3 million liters per day (mld), but the groundwater currently extracted is about 58.6 mld (Stanley 1994; Metcalf and Eddy 1999). The groundwater level has lowered from 9 meters to as deep as 68 meters. Unfortunately there is little support from the surrounding watershed areas to replenish the groundwater resource in the Valley, as much of the surrounding area has been turned into agricultural land.

Water Quality

Table 5.6 shows the water quality of eight major rivers across the country. The water of these rivers is used for different purposes including drinking, bathing, washing, swimming, irrigation, and disposal of cremated human bodies. In most cases, pH values are within the World Health Organization (WHO) guidelines; three sites have total dissolved solid amounts below the WHO value; all sites show a dissolved oxygen (DO) level equal to or above the WHO value; and all four sites have biological oxygen demand (BOD) values below the WHO value. On the whole, the water quality of the selected river sites is good compared with the WHO guideline values.

The situation is very different in urban areas. The Bagmati is the major Kathmandu Valley river in terms of drinking water source, irrigation source, and religious importance. Now it is also known as the most polluted river. Figure 5.1 shows the quality of water in terms of BOD5 (BOD over 5 days) and DO before (Sundarijal headwater) and after (Sundarighat end point) the Kathmandu urban area, analyzed from 1988 to 1999 (UNEP 2001). The water at the latter site, particularly since 1994, is highly polluted, as indicated by the high value of BOD5 and low value of DO, as a result of the high concentration of domestic and industrial effluent. Some 21,000 kg of domestic sewage is discharged daily into the Bagmati River from Kathmandu Valley's cities—42% of the total BOD load produced. The total industrial BOD load discharged directly into the river is 3,151 kg per day (CEMAT 2000).

Other sources of drinking water also show poor quality. All the sources of water shown in Table 5.7 are used for drinking purposes in Kathmandu Valley. None of the groundwater sources such as dug wells, deep tube wells, and stone spouts, or surface water including ponds and rivers, or even piped water were found to be consistently free from fecal contamination. The degraded quality of groundwater in the Valley is due to polluted surface water, leachate, and sewage.

Groundwater is the main source of drinking water in the Terai region, meeting over 90% of the demand. But a recent study carried out by the Nepal Red Cross Society (NRCS 2003) indicated that all 20 Terai districts of Nepal have shown arsenic contamination in groundwater. According to the WHO guidelines, water from about one third of the total 29,804 tube wells tested is not acceptable for human consumption as it contains arsenic concentrations over 10 parts per billion (ppb). According to the Nepal Interim Standard of 50 ppb, water from 7% of the tube wells tested is not acceptable for consumption (Table 5.8). Based on water analysis of sample tube wells in four Terai districts (Nawalparasi, Parsa, Bara, and Rautahat), NRCS (2003) has found an arsenicosis prevalence rate of 2.2% among the risk population who are consuming water above 50 ppb. It is estimated that around 0.5 million people in the Terai are living at risk of arsenic poisoning (>50μg/L).

Table 5.9 shows the mineral and bacteriological contents of water from tube wells at selected sites in the Terai region. The concentration of iron and manganese is on the whole higher than the WHO standard. The water is also not free from coliform bacteria.

The reports show that the quality of both surface and groundwater sources in different parts of Nepal is degraded. This is the result of contamination by domestic and industrial waste, human-induced natural disasters, and agro-chemicals, and the effects of changes in land use patterns. All domestic sewers are discharged directly into rivers without treatment. Although this is primarily an urban problem, it also affects neighboring rural areas. Industrial waste is also a major cause of surface water pollution—40% of the country's 4,271 industrial units are reported to be water-polluting industries (CBS 1998). In terms of relative contribution of BOD load, the major polluting industries include vegetable oil, distillery, and leather. The average use of chemical fertilizers, such as nitrogen, phosphorous, and potassium (NPK) per hectare has increased tremendously from 7.6 kg in 1975 to 26.6 kg in 1998. However, the concentration of these nutrients is within the permissible level for river water quality. Finally, landslides, soil erosion,

Table 5.7: Bacteriological Water Quality of Different Water Sources, Kathmandu Valley

Fecal Coliform/ 100 ml	Value as % of Sample Units (n =16)								WHO Guideline Value
	Dug Well	Tube well	Deep[a] Well	Spring	Stone Spout	Pond	River	Pipe Water	
0	0	60	80	40	20	0	0	60	0
1–100	40	30	15	30	40	0	0	20	
101–1,000	30	5	5	30	40	0	100	20	
>1,000	30	5	0	0	0	100	0	0	

ml = milliliter, n = number, WHO = World Health Organization
Source: Pradhan (2000); [a]NWSC (2000)

Table 5.8: Arsenic Sample Tests in Nepal by Different Agencies

Source of Data	Arsenic (ppb)			Total Samples Tested	% of Samples Tested
	<10	>10-50	>50		
DWSS	6,769	2,023	1,217	10,009	33.58
NRCS	6,536	2,709	503	9,748	32.71
RWSSSP/ FINNIDA	3,131	306	191	3,628	12.17
NWSC	16	14	0	30	0.10
NEWAH	235	85	29	349	1.17
Plan International	2,778	2,171	70	5,019	16.84
RWSSFDB	887	122	12	1,021	3.43
Total Samples Tested	**20,352**	**7,430**	**2,022**	**29,804**	**100.0**
%	**68.29**	**24.9**	**6.78**	**100**	

ppb = parts per billion , DWSS = Department of Water Supply a nd Sewerage, FINNIDA = Finnish International Development Agency , NEWAH = Nepal Water for Health, NRCS = Nepal Red Cross Society, NWSC = Nepal Water Supply Corporation, RWSSFDB = Rural Water Supply and Sa nitation Fund Developme nt Board, RWSSSP = Rural Water Supply and Sanitation Sector Program
Source: Sijapati et al. (2003)

Table 5.9: Water Quality of Shallow Tube Wells in the Terai Region

Sites (District)	Chloride (mg/l)	Ammonia-N (mg/l)	Nitrate-N (mg/l)	Iron (mg/l)	Manganese (mg/l)	Coliform cfu/100ml
Panchgacachi (Jhapa)	15.4	0.70	0.2	6.0	0.8	11.1
Baijnathpur (Morang)	16.4	0.50	0.2	4.5	0.5	15.9
Bayarban (Morang)	17.6	0.50	2.4	6.0	0.6	0.5
Takuwa (Morang)	21.0	1.00	1.0	10.4	0.4	45.9
Shreepur Jabdi (Sunsari)	37.2	0.90	0.2	8.0	0.6	25.5
Bandipur (Siraha)	195.6	0.70	3.5	0.4	0.4	1.0
Naktiraipur (Saptari)	54.5	1.20	0.3	12.0	1.3	16.0
WHO Standard	250.0	1.24	10	3.0	0.5	nil

cfu = coliform units, mg/l = milligram per liter, WHO = World Health Organization
Source: ENPHO (1990)

and floods have often caused turbidity of river water. In the absence of proper protection, drinking water sources are polluted due to the floods during summer rainfall, which add turbidity and various nutrients to the river water.

Sanitation

Sanitation can be measured in terms of availability of sewerage and toilet facilities. Access of households to sanitation facilities increased from 6% in 1991 to 25% in 1999 and 46% in 2001. However, the majority of the population still practices open defecation. This is the major reason for the contamination of water sources, particularly in rural areas. There is a marked variation in access to sanitation between rural and urban areas. In urban areas, access to sanitation increased from 34% in 1991 to 67% in 1999, but in rural areas only from 3% to 18% (NPC 1992; NPC 1997; RWSSP 1999).

On the basis of water use per person per day, NPC (1997) estimated the wastewater generated to be 90% of the total per capita water consumption of both rural (45 liters per capita) and urban (60 liters per capita) areas. This means an estimated total wastewater generation per day of 807 million liters in rural areas and 174 million liters in urban areas. As there are no treatment plants outside the valley, this wastewater is assumed to be discharged directly into water bodies. There are effectively no wastewater or sewage treatment facilities in Nepal. Nominally there are four treatment plants in the country, all in the cities of Kathmandu Valley, but of these four, one is partly functioning and the remaining three are not functioning at all (Table 5.10). Thus in parts of Kathmandu Valley, there are sewerage lines, but the sewerage is discharged directly into the river. In 2001 it was planned to bring the defunct sewerage treatment station at Dhobighat into operation and construct an additional sewer line to extend the service in urban areas. However, as of 2006, the treatment station is still not in operation. In other cities and towns, there is storm drainage but no sewerage system.

Table 5.10: [Theoretical] Sewerage Coverage in Nepal

Description	1999	2000	2001
Total Length of Sewers (km)	220	225	232
Interceptors	33.7	38.7	40
Laterals	186.3	186.3	192
Number of Treatment Plants	4	4	4
Population Served	390,000	400,000	420,000
Population Coverage (%)	40	40	40

Source: NWSC (2001) p. 11.

Public Health Impacts

Water pollution is the most serious public health issue in Nepal. There is a vital connection between water and health. The rivers have become major places for urban solid waste disposal and dumping, and for industrial effluents, all of which are responsible for deteriorating the river water quality and contributing to waterborne diseases. In major urban areas, particularly in Kathmandu Valley, vegetables are cleaned with polluted river water, and during the dry summer season polluted river water is used for bathing and washing clothes, which may have adverse effects on human health. The inadequate amount of drinking water is also responsible for disease.

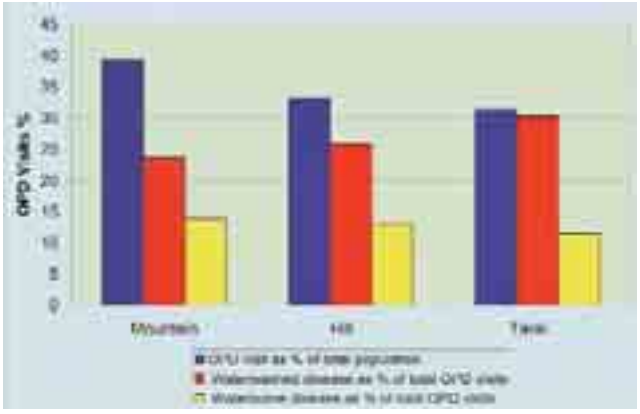
The total treatment capacity of drinking water in Nepal is much lower than the average amount of water produced (NWSC 2001). This means that the quality of drinking water is substandard. As noted in Chapter 2, water-related diseases are among the top ten leading diseases in the country. Of these, waterborne diseases (such as diarrhea, dysentery, cholera, and typhoid, resulting from consumption of

contaminated water) and water-washed diseases (due to poor sanitation such as worm infestation and skin diseases) account for 18% and 27% of the total outpatient department (OPD) visits in the country respectively (DOHS 2005). The proportion of OPD visits related to waterborne diseases ranges from as high as 24% in Dailekh and Arghakhanchi (hill districts) to 14% (Bhaktapur, Lalitpur, Jhapa, Parsa and Rupandehi). The proportion of visits related to water-washed diseases was highest in Parsa (Terai district) at 40%, and lowest in Dadeldhura (hill district) at 12%. These water-related diseases are generally caused by poor sanitation and poor water quality (DOHS 2005). Recent data from the Department of Health Services (2005) show that the incidence of diarrhea among children under five years of age is 222 per 1,000, up from 131 per 1,000 in 1996 (DOHS 1996). The reported mortality rate due to diarrhea was 0.34 per 1,000 children under five years of age in 1996, but has been reduced to 0.05 (DOHS 2005). This indicates a greater focus on curative aspects of the health services than on improvements in the quality of the water supply. The hospital records for Sukraraj Tropical Infectious Disease Hospital in Kathmandu show about 16% of all deaths as due to waterborne diseases (STIDH 2004).

Figure 5.2 shows the incidence of waterborne and water-washed diseases among outpatient visits to hospitals (DOHS 2003). Waterborne diseases refer to diseases due to consumption of contaminated water such as diarrhea, dysentery, and cholera; whereas water-washed diseases are due to poor sanitation conditions. The state of these two types of water-related diseases is usually used to describe the sanitation and health of any area. Among the regions, the proportion of water-related diseases is highest in the Terai.

The combined effects of land, soil, water, and air degradation on public health are significant, particularly for the rural poor. These effects have a great impact on their livelihood activities, because the poor already suffer from poor health as a result of inadequate diets, low income, and degraded living areas.

Figure. 5.2: Proportion of Water-related Diseases to Total Outpatient Department Visits, Nepal



OPD = Outpatient Department
Source: DOHS (2003)

Wetlands

Nepal's wetlands provide habitat for a number of endemic and threatened biological species, as well as for humans. Many ethnic groups rely on wetland resources for their livelihood. Wetlands are therefore valuable for the overall socioeconomic development of the country. Unfortunately, most of the wetlands and their rich biological resources, especially those in the Terai, are facing several threats due to the growing demand of the population for land and a variety of products and services. The threats include siltation, eutrophication, overexploitation of wetland resources, over fishing, hunting and poaching, overgrazing, illegal harvesting of wetland resources, encroachment, water pollution, developmental activities in adjoining areas, drainage, introduction of invasive species, and floods. Due to conflicts among the local people in claiming the resources in and around wetlands, and the absence of an effective mechanism to ensure the efficient local management of these valuable resources, valuable biological species are gradually becoming extinct.

Wetlands also provide habitat for thousands of water birds every year flying over an arduous 2,500-mile migratory journey from Siberia. Unfortunately, a crucial wetland resting point for these migrating flocks is drying up. The Koshi flood plain is flowing below its original capacity, at a level that is barely able to support the local birdlife population, let alone the 50,000 waterfowl that make up a spectacular migratory showcase in the Koshi River during the winter months each year (IUCN 1997).

The conservation of Nepal's wetlands should also call for promoting collaborative efforts such as community forestry programs and buffer zone management programs that have been successful in managing natural resources in the country.

Aquatic Biodiversity

Nepal is rich in aquatic floral and faunal biodiversity. Aquatic fauna species include fish, amphibians, and reptiles. Among aquatic fauna species, 34 are threatened and 61 are insufficiently known (Shrestha 1997). In Ilam in the eastern hills, katle (*Neolissocheilus hexagonolepis*) and silver mahseer (*Tor tor*) are reported to be endangered and threatened, respectively (MOFSC 2002). Three fish

species are reported to be endangered, five species threatened, and seven species restricted in the Gandaki River, west Nepal (Shrestha 1999). Over 100 dolphins (*Platanista gangetica*) were sighted recently in the Karnali River in western Nepal and around 20 more at the confluence of the Pathariya and Mohana rivers, the tributaries of the Karnali River, which lies 12 km southwest of Tikapur (Kailali district) in the western Terai region (MOFSC 2002).

The indigenous fish stocks have been declining due to over-fishing, harmful fishing practices (electro-fishing, dynamiting, use of chemicals), pollution, and development work (Shrestha 1999). Development works like river damming or hydropower projects have major impacts on river ecology and aquatic flora and fauna. The Government has made environmental impact assessments (EIAs) compulsory since 1993 under the EIA National Guidelines for all hydroelectric projects above 5 MW.

Compared with fish, there are very few studies on characteristic features of aquatic insects in Nepal. It is not yet known how many aquatic insects and animals are threatened or extinct.

There is a close association between quality of water and abundance and type of aquatic animals. In general, as the intensity of organic pollution increases the diversity of animals decreases and sensitive organisms are replaced by pollution-tolerant animals. The rivers of Nepal flow through diverse geographic environments and possess a variety of aquatic macro-invertebrate species. Most of them are pollution indicators and can be used to determine the quality of river water. The diversity and abundance of benthic macro-invertebrates indicates the specific characteristic features of different sites of a river. As the quality of a water body changes, the aquatic macro-invertebrates in that particular area will also change. They are either washed away or die depending upon their sensitivity to pollution. Therefore, benthic macro-invertebrates are very important in terms of classifying the quality of a water body. For example, the headwater region of the Bagmati River and its tributaries in Kathmandu Valley are rich in aquatic biodiversity, but poor where the rivers flow through the core city area because of organic pollution. Table 5.11 shows the comparative picture of aquatic macro-invertebrates in Kathmandu Valley and Nepal as a whole. This information can provide a baseline for future studies for comparison in terms of decrease or increase in the types of taxa, although as yet, no efforts are being made in this direction.

Table 5.11: Aquatic Macro-invertebrates in Kathmandu Valley and the Country

Aquatic Macro-invertebrate	Number	
	Kathmandu	Nepal
Coleoptera	15	181
Diptera	55	202
Ephemeroptera	33	29
Megaloptera	1	—
Odonata	5	2
Oligochaeta	5	—
Trichoptera	14	59
Gastropoda	7	—
Heteroptera	7	—
Plecoptera	9	67
Hirudinea	2	—

— = not available
Source: Pradhan (1998); Sharma (1998)

Efforts in Water Supply and Sanitation Improvement and Management

Attempts by government, nongovernment, community, and private organizations are underway to better develop, manage, conserve, and utilize water resources in Nepal, either through indigenous efforts or through economic and technical assistance from international and bilateral agencies. Two major efforts are noteworthy.

(i) The Water Resources Act 1992 is of great significance, as it vests ownership of all water resources with the State. Private ownership is disregarded. The Act has appropriately recognized drinking water as the first priority in terms of order of use, followed by irrigation, farming enterprises like animal husbandry and fisheries, hydroelectric power, cottage industry, water transport, and others.

(ii) The National Water Resources Strategy 2002 aims at developing and managing water resources for sustainable use, while ensuring conservation and protection of the environment in a holistic and systematic manner. The strategy not only takes into account water uses such as hydropower and irrigation but also recognizes other uses in areas such as tourism and fisheries. The current Tenth Plan (2002–2007) considers the river basin approach as the basis for the development and management of large rivers.

Drinking water is the basic minimum need of all human beings. Provision of convenient, safe, and adequate drinking water is the declared commitment of His Majesty's Government of Nepal. The Tenth Plan document states a goal of meeting 85% of the total water demand by the end of the plan period (2007) with gradual improvements in service levels, providing appropriate sanitation services in

rural and urban areas through community awareness programs, and reducing infant mortality by bringing about a reduction in water-related diseases. The following efforts are underway to increase people's access to drinking water: (i) Rainwater harvesting programs in feasible areas; (ii) Community based water supply and sanitation sector projects, particularly in the mid and far-western regions; (iii) Rural water supply project and water resources management programs by national and international NGOs in different areas; (iv) Community based rural water supply and sanitation programs; (v) A small town water supply and sanitation program; (vi) A water quality improvement program; and (vii) A sanitation education and hygiene promotion program.

In addition, the Irrigation Policy 2003 has adopted many significant initiatives to exploit groundwater for irrigation, particularly in the Terai region. The policy has also addressed the issue of arsenic contamination in groundwater used for irrigation.

Analyzing the National Water Supply Sector Policy's objectives, policies, and programs related to drinking water leads to several observations. First, they emphasize enlarging the drinking water coverage, but mere emphasis will not be adequate unless the quality (potable) and quantity (per capita) aspects of drinking water are considered. These two aspects of water are vital in terms of health and sanitation. Second, the health and sanitation education program to reduce water-related diseases will not be effective unless the water sector defines a Nepalese potable water standard. Further, the living standards of general rural communities must be raised by providing income-generating activities. This will enable them to pay ever-increasing water and sanitation tariffs. However, this issue is not only relevant to the drinking water sector, but interlinked with many other sectors related to water, sanitation, and health. It requires a coordinated effort to be made at national, sub-national, and local levels because water-related diseases relate to all of them.

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Chapter 6

Energy Resources

Introduction

The availability and use of energy is necessary for survival and prosperity. It is basic to any society's development and economic growth. Energy is used for many purposes in daily life and in the process of social and economic development, and the amount of energy consumed is an indicator of level of development and standard of living. Gross national income per capita is higher where per capita energy consumption is also higher. This indicates the link between prosperity and energy use in the present world—rich countries use a lot of energy. Nepal's per capita energy consumption is one of the lowest in the world as well as in South Asia, reflecting the low level of development and prosperity (Table 6.1).

Expanding economic activity and population growth are the two basic factors behind increases in energy consumption. In a country like Nepal, where economic growth is necessary and population growth is high, energy demand will continue to rise in the years to come. Energy consumption patterns and the rise in demand, their sources, and ways in which they are harnessed and utilized have implications for the environment and natural resources, which ultimately affect overall development.

Table 6.1: Energy Consumption and Per Capita Income

Category	GNI ($)	Energy Use Per Capita (kg oil equivalent)	Electric Power Consumption Per Capita (kWh)
World Average	5,120	1,686	2,159
South Asia Average	460	469	331
Countries in Different Income Groups			
Low Income	430	518	317
Middle Income	1,850	1,339	1,447
High Income	26,490	5,423	8,421
Selected Countries			
Norway	38,730	5,896	24,881
Switzerland	36,170	3,875	7,474
United States	35,400	7,996	11,714
Japan	34,010	4,099	7,237
United Kingdom	25,510	3,982	5,653
Singapore	20,690	7,058	7,178
China, People's Republic of	960	896	893
India	470	515	365
Bangladesh	380	153	94
Nepal	230	357	61

kg = kilogram, kWh = kilo watt-hour, GNI = gross national income
Note: GNI per capita is gross national product (GNP) divided by population.
Source: IBRD/WB (2004)

Sources and Consumption Patterns

Sources

Nepal's energy supply is primarily based on three sources.

Traditional (biomass). This includes fuelwood, agricultural residues, and animal waste. Biomass is the traditional source of energy in Nepalese society, which is predominantly rural and agricultural. People in rural areas do not have to pay for biomass—it is either available free from nature (fuelwood collected from a nearby forest) or is a byproduct of agricultural activities (agricultural residues and animal dung). In the past, there was an abundant supply of biomass from the forest and agricultural activities. The situation has been changing in recent times due to increases in population, long-term decline in forest areas (despite recent increases), and rising demand for energy. Biomass is becoming scarce and biomass sources are under increasing pressure, with potentially adverse consequences on agriculture and the environment. However, rural people continue to use biomass as an energy source because they have no other options and they do not have to pay for it.

Commercial. Commercial energy, also known as conventional energy, is traded in the market and in Nepal this comprises coal, electricity supplied through the national grid, and petroleum products. Hydropower is the main source of electricity in Nepal.

Definition, Forms, and Units

Energy is the capacity of matter to do work in relation to forces acting on it. Five forms of energy are often distinguished: (i) Mechanical, (ii) Electromagnetic, (iii) Thermal, (iv) Chemical, and (v) Nuclear. Energy conversion takes place among and within these forms in the process of human production and consumption, as well as in nature; for example burning fuels to produce heat converts chemical energy to thermal energy (i.e., burning wood releases stored chemical energy, but all is not converted to heat; if heat is the desired form of conversion, conversion to other forms are losses). The efficiency of conversion from one form to another depends on the extent to which unwanted dissipation can be avoided. Unwanted dissipation in the process of conversion and use is energy lost.

The most common energy sources are biomass, solar, fossil, hydropower, wind, and wave. The sources can be classified as renewable or nonrenewable depending on whether they can supply continuously or will be exhausted. The primary source of energy available to us is the sun. The concept of renewable and nonrenewable energy is a relative one—it is basically a distinction about time and space-scale.

Energy is measured and expressed in various ways. Joule (J) is the internationally recognized unit for energy. Energy production and use involves conversion of energy from one form to another: the rate of conversion (or rate of doing work) is defined as power, which is commonly measured in watt (W): 1 W is 1 J per second. Electrical appliances have power ratings quoted as W or kW, such as a 40-W electric bulb. Kilogram of oil equivalent is sometimes used to bring energy consumption from different sources to a single, common unit and to express it in an easily understandable manner.

Source: Blunden et al. (1991)

Alternative energy. Biogas, micro-hydro, solar, and wind energy come under this heading. Biogas is a more efficient way of utilizing some biomass (animal dung) as energy. Hydropower (including micro-hydro), biogas, solar, and wind energy are renewable; within their re-generation capacity, these can supply energy indefinitely.

Nepal's indigenous energy resources include biomass, hydroelectricity, solar, and wind. Coal and petroleum products are imported, as the country has no known economically exploitable fossil fuel reserves. The potential of known indigenous energy resources in Nepal is estimated to be 1,970 million gigajoule (GJ) annually on a sustainable basis (WECS 1996), which would be 15 times the estimated total consumption. This indicates that there is sufficient potential energy supply from indigenous sources. Of the total sustainable potential, water resources represent the largest fraction (75%), with forests contributing 12%, and the rest coming from other sources.

Consumption Patterns

In 2002, Nepal's total energy demand was 8,883 thousand tons of oil equivalent. Energy consumption increased at an average rate of 2.5% per annum between 1993 and 2002. The annual per capita energy consumption is 347 kg of oil equivalent (CBS 2004).

The energy consumption pattern by source between 1993/94 and 2002/03 is shown in Table 6.1. Energy consumption is dominated by traditional sources, which accounted for about 87% of the total energy consumption in 2002/03, although its percentage of total consumption has been slowly declining (Table 6.2). Of the traditional sources, fuelwood accounted for 89%, agricultural residues for 4%, and animal waste for 6%. Fuelwood contributed 75% of the total energy consumed in 2002/03. This indicates the pressure on the traditional sources, primarily on the forests.

The share of commercial and alternative sources has been increasing, although at a slow pace. From 1993/94 to 2002/2003, consumption of commercial energy increased from 7.5% to 12% of the total energy consumed, and the contribution of alternative energy increased from about 0.1% to 0.5%.

The energy consumption by sector is shown in Tables 6.3 and 6.4. The residential sector consumed 90.6% of all energy consumed in 2003, followed by transport (3.9%), industry (3.4%), commercial (1.2%), agriculture (0.8%), and others (0.1%). Although the amount of energy consumed has increased, the share of energy consumed by different sectors has remained more or less unchanged over the last decade.

The residential sector mainly consumes traditional fuels, whereas the "other" sector consumes commercial fuels. Residential consumption accounts for around 98% of the traditional fuels consumed in the country. Cooking is the main residential use of energy in rural areas, where the majority of people live, and fuelwood is the main source (household cooking consumes 65% of all rural energy). The residential sector consumes 99% of total fuelwood consumption. In urban areas, kerosene, liquefied petroleum gas (LPG), or electricity is used for cooking (MOPE 2003). Nepal imports all petroleum products and coal, most of which is consumed by automobiles and industries.

Nepal's energy supply and consumption patterns are overwhelmingly dominated by traditional biomass sources and residential uses, respectively. The principal use of biomass energy in

Table 6.2: Energy Consumption Pattern by Source 1993/94 –2002/03

Year	Energy Consumed ('000 toe)				Percentage of Energy Consumed			
	Traditional	Commercial	Other	Total	Traditional	Commercial	Other	Total
1993/94	5,933	483	6	6,422	92.4	7.5	0.1	100
1994/95	6,059	582	8	6,649	91.1	8.8	0.1	100
1995/96	6,185	651	11	6,847	90.3	9.5	0.2	100
1996/97	6,268	691	15	6,974	89.9	9.9	0.2	100
1997/98	6,403	769	21	7,193	89.0	10.7	0.3	100
1998/99	6,540	811	25	7,376	88.7	11.0	0.3	100
1999/00	6,681	1,044	29	7,754	86.1	13.5	0.4	100
2000/01	6,824	1,095	34	7,953	85.8	13.8	0.4	100
2001/02	6,996	1,169	39	8,204	85.3	14.2	0.5	100
2002/03	7,240	1,003	39	8,282	87.4	12.1	0.5	100

toe = tons of oil equivalent
Source: MoF (2003)

Table 6.3: Energy Consumption by Sector ('000 GJ)

Sector	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Residential	254,853	260,951	267,542	274,341	281,533	287,815	295,159	301,143	314,655	320,268
Industrial	9,231	11,084	11,771	6,417	6,921	7,522	15,717	12,998	12,537	11,969
Commercial	2,206	2,558	2,840	3,179	2,919	3,215	3,708	4,128	4,921	4,081
Transport	6,682	7,839	8,721	11,942	13,546	14,849	12,798	13,592	12,025	13,850
Agricultural	535	640	690	966	1,099	711	2,968	3,152	2,776	2,888
Other	206	243	262	293	322	342	355	409	454	484
Total	**273,712**	**283,315**	**291,827**	**297,139**	**306,339**	**314,454**	**330,706**	**335,421**	**347,369**	**353,541**

GJ = gigajoules
Source: Water and Energy Commission Secretariat, Kathmandu , 2005. Unpublished data file.

Table 6.4: Share of Energy Consumption by Sector

Sector	1994	2003
	%	%
Residential	93.1	90.6
Industrial	3.4	3.4
Commercial	0.8	1.2
Transport	2.4	3.9
Agricultural	0.2	0.8
Other	0.1	0.1
Total	**100.0**	**100.0**

Source: Water and Energy Com mission Secretariat, Kathmandu , 2005. Unpublished data file.

rural Nepal is burning in traditional cooking stoves or open fires. This is very inefficient, as most of the heat generated is lost. It is possible to increase the efficiency by introducing better technologies such as improved cooking stoves.

Hydropower

Nepal is rich in water resources. The gradient provided by the mountain topography, monsoon rain, and Himalayan-fed rivers offer great potential for hydropower development (Tables 6.5 and 6.6). The hydropower potential in Nepal is estimated to be 83,000 megawatts (MW), of which 42,000 MW is economically feasible at present. A substantial proportion of the potential is based on reservoir projects.

The National Water Plan (2002–2027) estimates that the maximum domestic demand for power by 2027 will be less than 7,000 MW even under a high-growth scenario—this is only about 17% of the economically feasible potential. This indicates that Nepal will have substantial surplus potential for the foreseeable future, and in theory the surplus could be exported to neighboring countries, particularly to India and Bangladesh where there are energy shortages.

Nepal has been keen to encourage hydropower development. The Water Resources ACT 1992, Hydropower Development Policy 1992 and 2001, Electricity Act 1992, and Environment Protection Act 1996 are milestones in this direction. However, despite the great potential and the Government's emphasis on developing hydropower, the

Table 6.5: Hydropower Potential

River Basin	Theoretical Potential		Economically Feasible	
	GW	%	GW	%
Sapta Koshi	22.35	27	10.86	26
Sapta Gandaki (Narayani)	20.65	25	5.27	13
Karnali and Mahakali	36.18	43	25.10	60
Southern Rivers	4.11	5	0.88	2
Total	**83.29**	**100**	**42.13**	**100**

GW = gigawatt
Source: WECS (1995); USAID -SARI (2002)

Table 6.6: Summary of Hydroelectric Development Opportunities

Category	Number of Projects Identified	Total Capacity (MW)	Total Generation Potential (GWh/y)
10–100 MW (medium)	157	6,200	38,000
100–300 MW (medium)	47	7,815	42,056
300–1,000 MW (large)	20	9,437	45,723
> 1,000 MW (large)	5	19,463	50,985
Total	**229**	**42,915**	**176,764**

GWh/y = gigawatt -hour per year , MW = megawatt
Source: WECS (2002)

contribution of hydroelectricity to the overall energy production has so far been very small—only about 1% of the total energy need is met by hydropower. Power produced by the hydroelectric plants connected to the national grid mainly supply electricity to urban areas and their peripheries. At the end of the Ninth Plan (1997–2002), the national grid supplied electricity to an estimated 33% of Nepal's population, and an additional 7% had access to electricity generated from alternative energy sources like micro-hydro and solar (NPC 2002). A large part of the rural population is deprived of electricity.

Some of the factors contributing to the low level of hydropower development are lack of infrastructure and capital, high cost of technology, political instability, lower load factor due to low productive end-use of electricity, and high technical and non-technical losses. Despite its huge potential and acknowledged importance in national development, hydropower development has been lacking. The main concerns related to hydropower development in Nepal include the following.

High Tariff

Nepal's electricity tariff is comparatively high. In 2004, the average tariff in Nepal was NRs 6.7 per kilowatt-hour (kWh) ($0.091 per kWh), among the highest in the developing countries of Asia. The marginal rate for domestic energy consumption above 250 kWh/month is NRs 9.9 per kWh (US$0.134 cents per kWh), which is equivalent to or higher than the tariff in many developed countries (NEA 2005). The reasons for the high tariff include high production costs, high transmission and distribution losses due to technical losses and theft, inefficiency in management, and non-payment (or payment in arrears) from public sector customers. Further, the Nepal Electricity Authority (NEA) has been purchasing power from independent power producers at rates higher than its own current average cost of production. Power purchase agreements between independent power producers and NEA are on a ''take or pay" basis that requires NEA to pay for all energy produced in all seasons whether it is utilized or not, and the power purchase agreements are based on US dollar rates. The tariff is charged based on cost of production and with the intention of recovering costs, although Nepal received significant foreign finance as soft loans and grants. All of these factors result in high tariffs.

The cost of hydropower development in Nepal is high (typically NRs 5 per KWh for run-of-river plants), which is generally attributed to the fragile, unstable geology of hydropower sites (as well as remoteness of the sites which require building costly roads and infrastructure for access as part of the project cost), limited manufacturing capability related to hydropower plants (or grant or loan conditions tied to purchasing equipment from the country providing the grant), extensive employment of high-cost international contractors and consultants, and heavy reliance on bilateral and multilateral financing(WECS 2002, WECS 2004, USAID-SARI, 2002).

Slow Development

Although the first hydroelectric power plant in the country was established in 1911 at Pharping, by 2003 Nepal's total installed capacity had reached only 546 MW (about 1.3% of the feasible potential), which includes 144 MW hydropower produced by the eight independent power producers. In addition to hydropower, six thermal power plants owned by the NEA produce 57 MW. Thus total installed capacity in the country available in the integrated national power system is 603 MW.

NEA's monopoly until 1992 is cited as a reason for the slow development of hydropower in Nepal. Recent policies adopted following restoration of the multiparty system allow private sector development of hydropower, and since then several projects have been constructed by domestic and international

private companies. Now some 21% of the installed capacity comes from the private sector. The Government's emphasis on large, export-oriented projects is another reason for the slow development of hydropower. In the past, the Government gave priority to mega-power projects such as the Karnali, Arun, and Pancheswor, with the aim of exporting power to India rather than meeting Nepal's own needs. However, development of these projects has been hampered because there was no ensured export market in the absence of a power purchase agreement with India. There appears to be a "buyers monopoly", as India is the only potential market and India has been unwilling to pay commercial rates for energy or to put an economic value to the other benefits, such as flood control, that India can derive from developing hydropower projects in Nepal.

Problems with Dams

Although much of the hydropower potential in the country can be exploited through run-of-the-river projects, a portion requires construction of dams. Development of dams is seen as a means to provide water for consumption, clean energy, and flood control. However, experience in the construction, operation, and maintenance of dams is in its infancy. Development of large hydro dams is complex in this geologically unstable area, and in light of the poor infrastructure in many mountain areas. Concerns are often voiced about the impact on local populations and the environment (see Energy and Environment section below). Small- and medium-scale dam projects of up to 100 MW are sometimes suggested as a more environmentally friendly alternative to large hydro projects (Gubhaju 1994; WCD 2001). This debate, and the complex construction requirements, have also slowed hydropower development in the country.

Inadequacy in Linking Hydropower Development with National Development

Hydropower is termed "white gold", and its development can play a vital role in the development of Nepal. Although hydropower's importance in national development is acknowledged by all, efforts to develop it appear to lack a long-term vision, plans, and strategy that clearly identify linkages with national development goals. As an example, hydropower development could be linked with industrial and electric transport development and development of rural areas. Much of the debate however, concentrates on issues of export versus domestic consumption, small versus big projects, and reservoir versus run-of-river projects rather than on how Nepal could best benefit from hydropower development. Project identification and development often take place in isolation, not as an integrated, coordinated plan to stimulate the national economy and social development. It is assumed that each individual project will automatically bring socioeconomic development, which is hardly the case.

Financial Constraints

NEA's hydropower production cost in Nepal is around $3,000 to $4,000 per kW constructed—two to four times more than the cost in the neighboring People's Republic of China, India, and Bhutan. But the private sector projects cost between $1,500 and $2,500 per kW constructed. Hydropower development requires high capital investment. Donor assistance and government funds have been the major source of finance for hydropower projects. In the past, as much as 80% of all investment requirements came from multilateral and bilateral donor assistance (USAID-SARI 2002). Private-sector investment in hydropower has gradually increased since 1992. This needs to be further promoted as the availability of donor funding is declining, and public funds are more needed by the social sector. The domestic and international private sector could be a greater source of investment if an appropriate and favorable environment for competition and cost reduction were created.

Building National Capacity

Nepal's hydropower development has relied largely on imported technology and expertise. This situation is obviously undesirable in the long run. Capability is needed in all fronts of hydropower development, including planning and design, construction and management, and manufacturing hydropower-related plants and accessories. Although national capability has been developing and smaller projects are now being constructed with experts and

Chilime Hydropower Company Ltd

Chilime Hydroelectric Plant Headworks

Chilime Hydroelectric Project: An Example of National Effort in Hydropower Development, Completed August 2003

The Chilime Hydroelectric Project (CHP) has an important place in the history of hydropower in Nepal. It is a medium size run-of-river scheme with a rated capacity of 22.56 MW. CHP is the first hydropower project of this size in Nepal that was planned, designed, financed, and constructed by the Nepalese themselves without outside technical assistance. Most of the components including surge tank, power house, transformer cavern, penstock shaft, and tunnel are underground. CHP is funded with a debt:equity ratio of 60:40. It received short-term and long-term loans from Nepalese financial institutions, mainly from Karmacari Sanchaya Kosh (Employees Provident Fund) and Nagarik Lagani Kosh (Citizens Investment Trust). Nepal Electricity Authority (NEA) holds 51% of the equity, while NEA employees hold 25% and the general public 24%.

Nepalese expertise, contractors, and manufacturers were utilized to the extent possible. Nepalese construction companies were employed for construction of the access road and camp infrastructure; the headwork structure including the diversion structure, the intake, gravel trap, approach canal, reservoir overflow spillway, and desander; and other surface structures such as the power canal, siphon, and pressure conduit. Underground civil structures were contracted to an Indian company; however, Nepalese companies, under subcontracts with the main contractor, carried out tunneling and other underground construction activities. Nepalese contractors and manufacturers completed hydro-mechanical works including gates and stop logs, as well as the steel siphon pipe structure. The supply and erection of electrical and mechanical equipment was done by a German company.

CHP consulted and involved project-affected people, local communities, and their representatives in the project from an early stage. A mechanism was formed to facilitate and ensure implementation of social and environmental measures to mitigate adverse impacts and to enhance project benefits to the locality.

With the experiences gained from CHP and other recent hydropower projects, there is confidence now that the Nepalese are competent to plan and develop run-of-river hydropower projects up to 100 MW. It took about 10 years for CHP to generate electricity commercially, including a three-year delay due to termination of the original contract with a Chinese contractor, and transport and other difficulties caused by political instability and others. Lessons from CHP and recent similar projects suggest that projects of this size could be completed in about 5 to 6 years if planned and managed properly. The total cost of CHP development was about NRs 2.45 billion (or about $35 million—$1,550 per kW). This is comparable to the cost of similar-size projects in the region including in India and Bhutan. The per unit cost could be further reduced if electrical and mechanical equipment manufacturing capacity were developed in the country.

Source: Bhattarai (2005) and personal communication.

technology largely available in Nepal, capacity is growing at a very slow pace and is still very limited and far less than necessary.

In light of the above concerns, hydropower development in Nepal should be guided by a broad perspective. Common recommendations made in this regard include the following (USAID-SARI 2002).

Improve power system planning. This may include selection of an optimal generation mix; introduction of storage projects to increase the system's capacity, optimization of installed capacity based on a "systems concept" rather than on an isolated project optimization basis, interconnection with India to take advantage of coordinated operation of hydropower and thermal dominated systems, implementation of demand-side management to improve the load factor and reduce high system losses, and use of investment planning tools suitable for hydro-dominated systems.

Increase access to electrification in rural areas. This may include: grid-based rural electrification, mini and small hydro-based local grids, and use of other renewable sources like solar, wind, and biogas.

Raise the needed investments for hydropower development. Hydropower development is very capital intensive. Government and donor funds are not enough. Hence, the investment requirements of the power sector have to come from the private sector.

Strengthen institutional and agency involvement in the power sector. The policy, regulatory, and operational functions of the organizations involved in the hydropower sector should be defined to eliminate overlap in their work. Institutional strengthening should also be geared towards development of multipurpose projects that can have benefits of cost sharing and optimum utilization of the available water resources.

Promote power exchange and export with neighboring countries, particularly with India. The Government should hold talks with concerned authorities in India to move this ahead and consider allowing independent power producers to negotiate power purchasing agreements directly with power purchasers in India without having to go through the Ministry of Water Resources of the Government of Nepal as is the current practice.

Reduce the cost of hydropower development. The cost of hydropower projects can be reduced significantly if the Department of Roads would coordinate with the NEA in aligning planned roads to provide close access to potential hydropower sites that have been identified by the NEA.

Alternative Energy

At present, alternative energy is the preferred choice for rural areas of Nepal for various reasons. However, this might change over time as the country develops and the national grid can supply electricity to remote rural areas at an affordable tariff. Some reasons for preferring alternative energy sources at present are discussed here. First, the excessive dependence on traditional biomass energy (fuelwood, agricultural residues, and animal waste) and their inefficient use has undesirable implications for the environment, health, and economy. Furthermore, commercial fuels are not easily available in remote areas (this might change with improvement in access). Most rural areas of Nepal do not receive electricity from the national grid, and the situation is unlikely to change in the near future because the integrated national power system is already overburdened, the terrain in the Himalayan mountains is difficult, and population density is low. The price of commercial energy (electricity from the national grid as well as kerosene and LPG), where available, is generally beyond rural people's purchasing capacity, whereas traditional biomass fuel is free of cost. Therefore, people continue to use the traditional energy even where commercial energy is available. Thus alternative energy can play a significant role in remote and rural areas.

Despite its importance and desirability, a major hurdle in promoting alternative energy is its high installation cost. Sustainability of alternative renewable energy is often questioned, as it cannot freely compete with grid electricity and petroleum fuels in the existing national and global market and energy systems. The market, however, is imperfect as it does not reflect environmental costs. Hence, there is a strong argument for a set of strategies, policies, and subsidies favoring alternative renewable energy. The Government has been providing subsidies to alternative energy since the Eighth Plan (1992–1997), which is the main promotion of alternative energy in Nepal. Major issues related to subsidies are that the policy has frequently changed or been inconsistent, causing difficulties and frustration to the stakeholders involved; subsidies have depended on donor assistance and continuity cannot be relied upon, as donor priorities can change; many of the benefits of subsidies go to suppliers rather than to people; and finally, subsidy schemes usually fail to consider operation and maintenance, and as a result a significant proportion of alternative energy technologies cease to function soon after being installed.

DHM

The highest micro-hydropower plant in Nepal at Tsho Rolpa (approx. 4,500 masl)

Micro-hydropower

Hydropower schemes in the range of 5 kW to 100 kW units are a suitable and common choice for the rural hilly areas of Nepal due to low capital investment, simple technology for which Nepal has in-country capacity, hilly topography, fairly high rainfall, numerous streams, and scattered rural settlements and communities.

Micro-hydro electrification started in the 1970s, and the Government began encouraging it in 1980 through a subsidy scheme. The installation of electrification schemes has been rising sharply since the mid-1990s following the inception of the Rural Energy Development Programme and establishment of the Alternate Energy Development Center. There are around 2,000 micro-hydropower plants in Nepal with a total capacity of about 12 MW—nearly 3% of the country's total hydroelectric power output (MOPE 2003; Basnyat 2004).

Despite its potential and advantages, there are constraints and obstacles to micro-hydro's widespread development.

The electricity generated from micro-hydro has been used mainly for evening lighting. Thus, the peak

M. Shrestha

Ghatta, a water-powered mill

load occurs from 6 pm to 9 pm with low utilization at other times. Low load-factor is a consistent problem for micro-hydro and affects the sustainability of micro-hydros schemes. There is a need to link micro-hydro with micro-enterprises in rural communities. Diesel and water mills are competitors of the micro-hydro plants.

Repair and maintenance is a major problem faced by micro-hydro plants installed by outside agencies. Operation, maintenance, and management are done locally, but there is general lack of technical skills and management capacity at the local level. As a result, a significant proportion of micro-hydro plants are non-functional.

Micro-hydro plants and civil structures are susceptible to damage by landslides and monsoon floods due to the mountain terrain and high rainfall.

A micro-hydro plant may require diversion of water used for irrigation and other purposes. As a result conflict may arise over water rights.

Peltric sets are also used to generate hydro-electricity. These are small units of vertically mounted impulse turbines coupled with induction generators that generate small amounts of power (less than 5 kW) and are suitable for providing electricity to a few households.

People in the hills of Nepal have traditionally used river water to run water mills (*ghattas*) that generate mechanical power used for agro-processing. These water mills are typically of less than 1 kW output capacity. It is estimated that there are over 25,000 ghattas in Nepal (MOPE 2003). Government agencies as well as several nongovernment organizations and private agencies are involved in improving these ghattas by replacing wooden water wheels with steel wheels and round buckets. Many of these improvements also include electricity generation during evening hours.

Biogas

Biogas, a methane-rich gas, is produced by anaerobic digestion of animal and human excreta. Livestock keeping is an important and integral part of Nepal's rural livelihood and farming system. Significant amounts of biogas can be produced using cattle and buffalo dung. The estimated potential for biogas production in Nepal is around 1,200 million cubic meters per year, which is equivalent to 29 million GJ (WECS 1999). By 2004, more than 120,000 plants had been installed in Nepal with support from the Biogas Support Program (BSP Nepal 2005). Various agencies such as NGOs are active in the promotion of biogas plants.

Biogas plants are particularly suitable in the Terai region where the climate is warm. As they require animal dung, rural households with livestock are the potential users, however, the poorest of the poor who have no livestock are unlikely to benefit. Biogas plants can also be attached to a toilet. The optimal temperature for biogas production is 35°C thus the high altitude mountain regions and winter season are unfavorable for gas production. It is estimated that a total of 1.9 million biogas plants can be installed in Nepal of which 57% would be in the Terai, 37% in Hill, and 6% in Mountain regions (BSP Nepal 2005). Special technical measures, such as heating the system by solar energy or biomass fuel, or using part of the gas produced for heating and using enzymes to digest the waste at low temperatures, may allow operation of biogas plants in colder conditions, but this will add to the cost and complicate operation and maintenance.

Solar

Solar energy has been used traditionally for drying crops, clothes, fuelwood, and others. Nepal has about 300 sunny days a year, and the average insolation lies between 4 and 5 kWh/m^2/day (WECS 1996; MOPE 2003). Nepal's solar energy potential is estimated to be about 26 million MW (WECS 1996). There are basically two methods of utilizing solar energy—solar thermal systems and solar photovoltaic systems. Solar thermal systems use solar radiation directly for heating, whereas solar photovoltaic systems generate electricity from solar radiation. An estimated 20,000 solar water heaters have been installed in Nepal (REDP 2002, cited in MOPE 2003). Nepal Telecommunications Corporation has installed more than 6,000 units of 50 W module solar photovoltaic systems; around 22,000 household solar photovoltaic systems have been installed, and the Nepal Electricity Authority has installed three 30–50 kW capacity solar photovoltaic stations at Simikot, Gamgadi, and Tatopani (MOPE 2003). The Mountains and Hills have a great solar energy potential, accounting for almost 94% of the total solar energy output in Nepal.

Solar home systems typically consist of a 32–36 watt solar panel, lead acid battery, charge controller, and energy-efficient lights. This is generally sufficient to operate three lights for approximately 4 hours per day. The solar home system is particularly suitable for remote rural areas where there is no other means of electricity supply. They are less likely to be destroyed by the monsoon floods and affected by temperature extremes.

Wind

Wind power development is still at an experimental stage, and no effort has yet been made to harness wind energy. Lack of wind data for proper

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Biogas Installation for a Rural Household

assessment of wind energy and lack of technical expertise are the main obstacles to wind power development in Nepal. Although sufficient wind data are not available, a number of areas have constant high wind speed, such as several mountain ridges, the Mustang Valley, and the Khumbu region. A potential of 200 MW wind power in a 12 km corridor from Kagbeni to Chusung could generate about 500 gigawatt hour (GWh) (CBS 1998). Wind or wind/solar photovoltaic hybrid systems using small wind turbine technology currently available in the international market may well be feasible in some areas of Nepal. The nature of wind patterns indicates that small-scale (1–50 kW) wind generators may be feasible in remote and isolated places (MOPE 2003).

Energy and Environment

Energy and environment are related in complex ways. The production, distribution, and consumption of energy have direct and indirect environmental implications. Some of the environmental issues are global, like the greenhouse effect and climate change. However, Nepal's contribution to global environmental degradation is insignificant as Nepal's per capita annual energy consumption is one of the lowest in the world. Most environmental concerns related to energy sources and uses in Nepal are, therefore, related to national and local consequences.

Biomass Energy

The trend suggests that demand for biomass energy has been rising and will continue to rise. Low efficiency is a common feature in the traditional residential use of biomass energy. Environmental problems include the following.

Indoor air pollution. Inefficient burning of biomass coupled with poor ventilation is the principle cause of poor indoor air quality in rural Nepal (MOPE 2003). Indoor air pollution has detrimental health implications (see Chapter 7).

Pressure on forest. Fuelwood is the main source of energy in rural Nepal. This is putting significant pressure on the forest resources, even though this may not be the primary cause of deforestation in the country. As the human and livestock population continue to grow, demand for firewood will rise in the absence of other appropriate alternatives.

Impact on agriculture. As firewood becomes scarce, rural people are increasingly burning agricultural residues and cow or buffalo dung as domestic cooking and heating fuel. People in the densely populated Terai regions, and some mid-Hills areas, particularly rely on these sources. In Nepal's traditional farming system, agricultural residues and animal wastes are the main source of organic matter and nutrients for the soil. Burning these deprives the soil of organic matter and essential nutrients, affecting crop yield.

Fossil Fuels

The share of fossil fuels in Nepal's overall energy consumption is very small. However, consumption has been growing consistently (CBS 2004). Industries and automobiles are the main consumers of imported fossil fuels. Environmental concerns of fossil fuel consumption relate to emission-related air pollution, which is becoming a sensitive issue in urban and industrial areas, and their peripheries.

Hydropower

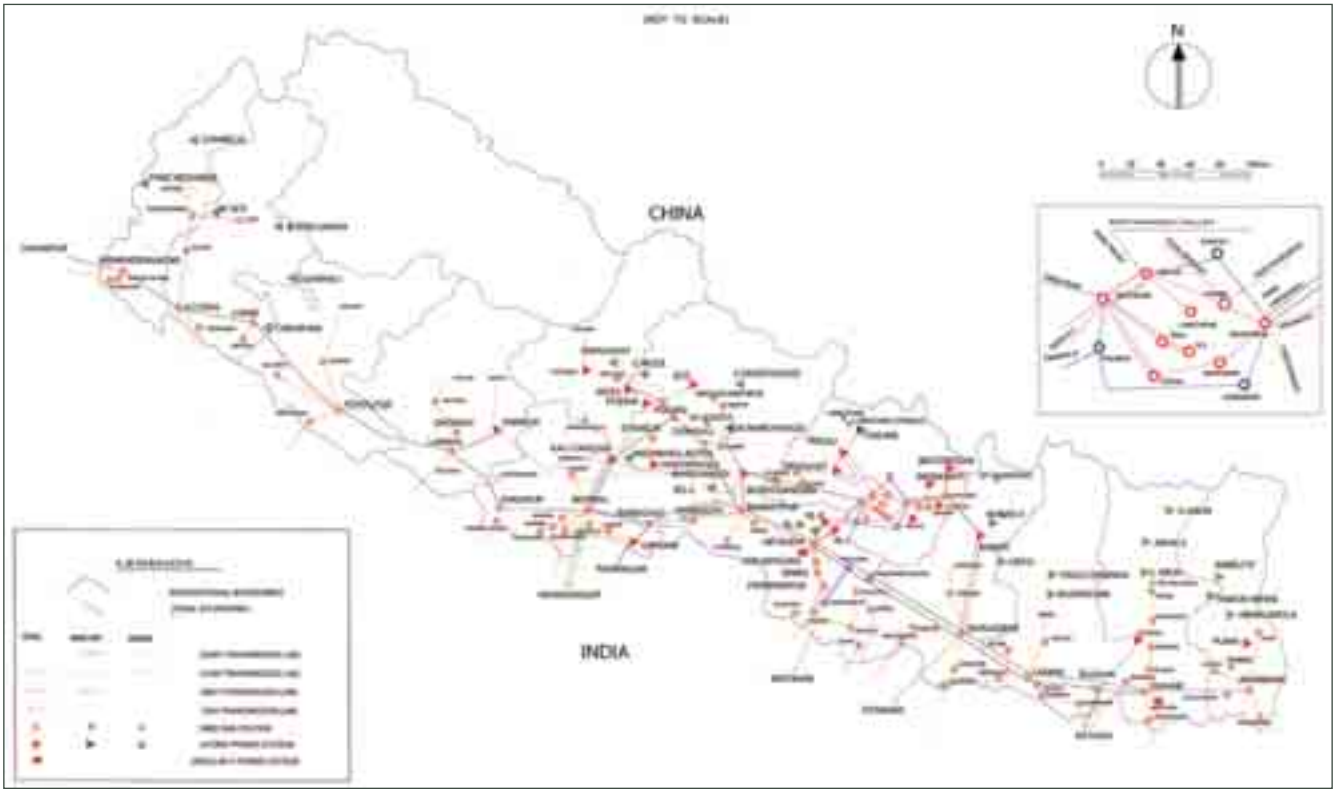
Hydropower is renewable clean energy. Therefore, environmental concerns of hydropower are related to development and production stages rather than consumption. The severity of these concerns depends on the size, type, and location of hydropower projects—the bigger the project, the greater the environmental impacts. Reservoir projects are likely to result in much higher environmental and social impacts than run-of-river projects. Many bigger hydropower projects around the world have become environmentally and socially contentious and many have encountered unanticipated difficulties in the course of development or operation. For example, the Arun III hydropower project in Nepal has been dropped following protracted environmental debate, and the Kulekhani reservoir project encountered a heavy siltation problem that was unsuspected during its planning and design. The main environmental concerns related to bigger hydropower projects include the following.

Impacts downstream. Water diversion can result in undesirable consequences downstream. These typically include, but are not limited to, depriving downstream users of water for irrigation and other traditional uses, degradation of water quality, and reduction in flows harming riparian ecosystems and aquatic life.

Inundation. Inundation upstream of dams can result in submergence of houses and settlements, fertile agricultural land, forest and other vegetation, and others.

Displacement. People can be displaced as direct or indirect consequences of a project, or livelihoods can be affected due to degradation or loss of private land and properties, resources, and local infrastructure and amenities. Quite often poor

Figure 6.1: Power Development Map of Nepal: Major Power Stations, Transmission lines, and Substations



Source: NEA (2005)

and marginal people are the worst affected. Most of the project beneficiaries live far from the project site while the people living around the project are adversely affected.

Physiographic risks. There is a high risk of damage to civil structures and plants by landslides as a result of the fragile physical setting of the Himalayan range and monsoon floods. Glacial lake outburst floods (GLOF) also pose a threat. These may not only damage the project but can also sweep away settlements, and destroy land and property downstream. The risk of reservoir siltation is also very high in the mountainous terrain of Nepal.

Impact on migratory fish. Hydropower dams can act as barriers to migration of fish, and projects can act as barriers to the movement of land animals or adversely affect their habitat.

It is now accepted that hydropower development needs to consider environmental and social consequences, and environmental assessment is now generally required to ensure this. Mitigation and compensation measures are part of the environmental assessment; measures such as compensation for loss of property, ensuring minimum downstream flow all the time, supporting the development of areas surrounding the project, and social upliftment programs in affected communities may be necessary. People should not be worse off due to a hydropower project, and project benefits should also go to those affected, adequately compensating the losses they incur.

Alternative Energy

Alternative energy such as from micro-hydro, biogas plants, or solar sources—as well as use of more efficient and environmentally sound technologies for biomass energy—has a number of environmental advantages over other energy sources available in Nepal.

Micro-hydro is a clean local source of energy suitable for hilly rural areas in Nepal. For rural communities, it can be an alternative to traditional biomass fuels and has a significant potential towards reducing the demand for traditional fuels (firewood) as well as imported fuel (kerosene).

Biogas is suitable for cooking and hence can substitute for firewood in rural areas, and reduce pressure on the forest. The Biogas Support Program estimates that 119,693 operating biogas plants save 239,386 tons of fuelwood, 3.83 million liters of kerosene, and 203,478 tons of bio-compost fertilizer in a year (BSP 2005). These savings would result in a positive carbon dioxide balance as well as carbon absorption. Use of biogas plants improves sanitary and hygienic conditions at the household level. The slurry produced by the biogas plants is rich in nutrients and can be used as manure. As biogas replaces firewood and kerosene, this helps improve

Review of Dams and Development by the World Commission on Dams

Conflicts over dams have heightened in the last two decades due largely to the social and environmental impacts. Social groups bearing the social and environmental costs and risks of large dams, especially the poor and vulnerable and future generations, are often not the same groups that receive the water and electricity services, nor the social and economic benefits from these. The debate is also related to many competing uses and needs of water—there is increasing concern about access, equity, and the response to growing needs. This could affect relations within and between nations; between rural and urban populations; between upstream and downstream interests; between agricultural, industrial and domestic sectors; and between human needs and the requirements of a healthy environment. These needs are intertwined. The debate about dams is a debate about the very meaning, purpose, and pathways for achieving development. Having conducted an independent, comprehensive, global review of dams and their contribution to development, the World Commission on Dams (WCD 2000) concluded the following:

(i) Dams have made an important and significant contribution to human development, and the benefits derived from them have been considerable.

(ii) In too many cases an unacceptable and often unnecessary price has been paid to secure those benefits, especially in social and environmental terms, by people displaced, by communities downstream, by taxpayers, and by the natural environment.

(iii) Lack of equity in the distribution of benefits has called into question the value of many dams in meeting water and energy development needs when compared with alternatives.

(iv Bringing to the table all those whose rights are involved and who bear the risks associated with different options for water and energy resources development creates conditions for a positive resolution of competing interests and conflicts.

(v) Negotiating outcomes will greatly improve the development effectiveness of water and energy projects by eliminating unfavorable projects at an early stage, and by offering as a choice only those options that key stakeholders agree represent the best ones to meet the needs in question.

The commission recommends that it is necessary to break through the traditional boundaries of thinking and enshrine five core values in water and energy development: equity, efficiency, participatory decision-making, sustainability, and accountability. Decision-making needs to ensure: comprehensive approach to integrating social, environmental, and economic dimensions of development; greater levels of transparency and certainty for all involved; and increased levels of confidence in the ability of nations and communities to meet their future water and energy needs. The commission has proposed seven strategic priorities and related policy principles that water and energy resource projects should integrate in the planning and project cycles.

(i) Gaining public acceptance: Acceptance emerges from recognizing rights, addressing risks, and safeguarding the entitlements of all groups of affected people, particularly indigenous and tribal peoples, women, and other vulnerable groups.

(ii) Comprehensive options assessment: Alternatives to dams do often exist. The selection is based on a comprehensive and participatory assessment of the full range of options, and assessing social and environmental aspects at par with economic and financial factors.

(iii) Addressing existing dams: Opportunities exist to optimize benefits from many existing dams, address outstanding social issues, and strengthen environmental mitigation and restoration measures.

(iv) Sustaining rivers and livelihoods: Rivers, watersheds, and aquatic ecosystems are biological engines. Understanding, protecting, and restoring ecosystems at river basin level is essential to foster equitable human development and the welfare of all species.

(v) Recognising entitlements and sharing benefits: Joint negotiations with adversely affected people result in mutually agreed and legally enforceable mitigation and development provisions.

(vi) Ensuring compliance: Ensuring public trust and confidence requires that the governments, developers, regulators, and operators meet all commitments made for the planning, implementation, and operation of dams.

(vii) Sharing rivers for peace, development, and security: Storage and diversion of water of transboundary rivers has been a source of considerable tension between countries and within countries. Dams require constructive cooperation.

indoor air quality, with a positive impact on human health.

Having micro-hydro or solar electricity is important for rural villagers. It provides light for students to study, and powers TVs and radios that bring news and can be an important means of family entertainment. Substituting traditional biomass fuels with electricity has a number of advantages: (i) Improvement in indoor air quality by reducing or eliminating smoke, (ii) Reducing pressure on forest and saving time spent collecting firewood, and (iii) Electric light allows household families additional working time.

Where electricity and biogas are not practical, technologies such as improved cooking stoves can be promoted in rural areas. This will not only increase efficiency and reduce firewood consumption, but also reduce indoor air pollution and lead to positive health impacts.

Energy Policy and Plan

The Tenth Plan (2002–2007), Hydropower Development Policy 2001, Renewable Energy Perspective Plan of Nepal 2000–2020, Perspective Energy Plan 1991–2017, Water Resources Act 1992, and Electricity Act 1992 are the main policy, planning, and legislative documents guiding the energy sector in Nepal. These policies aim to attract local and foreign private developers to the hydropower sector.

The Tenth Plan (NPC 2002) emphasizes rural electrification and has a target to increase national electricity coverage from 40% to 55% over the plan period. The major strategies to be followed are promoting private sector participation, institutional reforms, establishment of a Power Development Fund, initiating an explicit subsidy policy for grid-based rural electrification, and creation of an independent regulatory body in the power sector. The highlights are summarized below.

(i) No license is required to generate hydropower up to 1 MW capacity, but projects must be registered with the District Water Resources Committee, and the Department of Electricity Development has to be informed.

(ii) A 35-year license will be provided for hydropower production for domestic consumption; 30 years for export.

(iii) Royalty rates will be based on project capacity and be higher for export-oriented projects than for domestic uses.

(iv) Institutional reforms will allow operating the generation, transmission, and distribution systems separately through autonomous public institutions, local bodies, and the private sector.

(v) A rural electrification fund to promote and develop rural electrification will be established, using a portion of royalties received from hydropower projects.

(vi) Various subsidy and incentive schemes will be established for alternative energy development, including micro-hydro, biogas plants, and solar-based electricity.

The Way Forward

Energy affects livelihood, wellbeing, and development in multiple ways. As population increases and the economy expands, people need energy in increasing amounts. How the present and future energy needs are met affects not only the environment but also overall development. Energy policy and strategy are linked with sustainable development approaches and environmental strategies.

The industrial world has already shown that its traditional mode of industrial development and energy consumption is not sustainable. Indiscriminate use of fossil fuel is leading to global environmental threats such as global warming and climate change. Industrialized nations need to change current practices to those using energy from cleaner and sustainable sources, and more efficiently than in the past. This shift will be difficult, costly, and painful for them as their current industries, economies, and lifestyle depend heavily on the use of fossil fuels.

Nepal is at a low level of industrialization. This provides an opportunity to learn from the already industrialized countries and to pursue a path that utilizes cleaner energy in an efficient manner. This should not be as difficult for Nepal as it would be for already industrialized countries, as Nepal does not need to shift from an already existing system to a new one, but to choose a more sustainable and benign path. Nepal therefore needs to pursue an energy policy and strategy that can supply energy for present and future use from sources that are dependable, affordable, safe, and environmentally sound. Nepal's energy development should therefore be guided by the following three basic principles.

Self-reliance in Energy and Promotion of Indigenous Renewable Sources

A massive promotion of indigenous renewable energy sources will be necessary. Nepal's indigenous energy resources—hydro, biomass, solar, and wind—are renewable, and their combined potential exceeds current demand as well as demand for the foreseeable future. In theory, therefore, energy shortages should not be a problem for Nepal, and

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Rural energy past and future: clockwise from top-collecting firewood for cooking (top); a simple peltric set can provide electricity for lighting in remote villages; improved cooking stoves reduce firewood use

renewable energy sources could contribute substantially to self-sufficiency. In reality, however, Nepal has not been able to harness its indigenous sources adequately and cost-effectively with two undesirable results—the energy available in the market is costly, and rural and poor people continue to depend on traditional biomass sources.

Relying more on indigenous renewable energy sources has a number of advantages. In addition to environmental benefits, such sources are less susceptible than imported fossil fuels to price fluctuations and foreign exchange rates, and their use means minimizing the risk of supply interruption due to external factors. But their development and use are constrained by the lack of national priority as well as inadequate national capacity in terms of finance, technologies, and institutions. Renewable energy sources (hydro, biomass, solar, and wind) require a much higher priority in national energy programs.

Having an Appropriate Mix of Energy Sources

Each energy source has desirable and undesirable environmental, economic, technical, and social dimensions. No single source is likely to satisfy all types of energy needs for all groups of users at all locations. Therefore, dependence on one source alone is not sustainable in the long run. Energy needs, availability, and costs can change over time. The long-term strategy, therefore, should encourage a suitable mix of sources, including hydropower, improved biomass use, solar, and other sources, that satisfies current and emerging demand and includes the necessary flexibility to respond to changing contexts. The energy mix desirable today could change over time with changing needs and advances in technology.

Reducing Consumption through Increasing Efficiency

Current energy consumption in Nepal is heavily dependant on biomass. Two issues related to this are first that biomass is used in a wasteful and inefficient manner that affects the health of consumers, and second, that although biomass is a renewable source, its supply is limited and cannot continue to meet growing demand without adverse impacts on the environment, economy, and health. The consumption and demand of non-biomass, commercial energy such as electricity and petroleum have been gradually increasing and this has been met by a corresponding increase in supplies, but efficiency in end-use has hardly received consideration.

Efficient use of energy is probably more important in the long run than increasing supplies. Promotion of energy efficiency in the production, supply, and consumption stages will not only reduce or check increases in demand, but will also have positive impacts on environment and health. Energy efficiency should be an integral part of national energy development and environmental policies.

One constraint to promoting energy saving and efficient use is the cost of energy conservation technologies and end-use devices that, most commonly, have to be imported. Investment in energy conservation and improved technologies and measures can save money over time because there will be reductions in the investment to increase supply. Improving efficiency can be less costly than investing in new projects to supply increasing energy demand.

Many energy efficiency measures, however, may cost little or nothing to implement—quite often energy can be saved simply by demand-side management. For example, differential pricing for use of electricity during peak and off-peak hours or during the monsoon when hydropower supply is greatest and winter when it is limited can promote more rational consumption behavior. Improved cooking stoves can substantially reduce fuelwood consumption in rural areas in addition to their benefiting health. These principles, however, should be applied in such a way as not to impede development.

Constraints. Pursuing the sustainable and environmentally sound energy path that enshrines these principles is not easy in the present national and global economic structure. This will require clarity as to how such an energy policy can be linked with sustainable development. For example, transport and industry are important for national development and are the major consumers of petroleum and coal, which are not only imported but also environmentally undesirable. With the right policy, transport can be promoted in a way that consumes energy from indigenous renewable sources like hydroelectricity.

Availability of funds and national willpower to implement the policy is another basic requirement. Most of the technologies will have to be purchased from more developed countries, which will be a major constraint for a country like Nepal. Initially, foreign assistance may be mobilized. Building national capacity in renewable energy technologies and manufacturing energy-efficient devices should be at the top of the energy development agenda.

Energy price. Price at the consumption point is probably the most important factor influencing energy consumption behavior. Pricing policy should

therefore reflect the three guiding principles discussed above: (i) Promotion of indigenous renewable energy sources, (ii) Appropriate mixes of energy sources, and (iii) Increasing efficiency. A well-devised system of subsidies, taxes, levies, and incentives is necessary for this to be realized. They should favor efficiency measures as well as environmentally sound energy production—pricing of energy could utilize the "polluter pays" principle and reflect external damage costs to health, property, and the environment. The demand for imported fossil fuels could be lowered through levies and changes in energy subsidies, energy efficiency in industries could be promoted through tax rebates for adopting energy-efficient technologies, and so on.

Energy should be available to all users at an affordable price. Scarcity of money is the immediate problem for the poor and this is frequently a greater concern for them than the shortage of energy, so cost is a major barrier to adoption of energy-efficient devices by the poor. The poor are forced to use inefficient end-use devices and fuels that are available free or cheaply because they lack money to purchase better choices, although at the end of the day, if all the direct and indirect costs are accounted for properly, they may be paying more per unit of delivered energy-services.

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Chapter 7

Air Pollution and Climate Change

Introduction

People can live without food and water for days, but cannot survive without air for even a few moments. An average person needs 13.5 kg of air every day. Dry air has concentrations of certain gases that are naturally present in the atmosphere. Any disturbance to the balance of the natural composition of air that has an adverse effect on people or the environment can be termed air pollution.

In pursuit of rapid economic development, many developing countries are confronted with environmental problems due to increasing air pollution resulting from industrialization, urbanization, and motorization. Worldwide, the World Health Organization (WHO) estimates that as many as 1.4 billion urban residents breathe air with pollutant concentrations exceeding the WHO air guideline values (WRI 1998). Although the causes and consequences of air pollution are often localized, transboundary movement of air pollutants has regional as well as global implications. Acid deposition, global climate change, and stratospheric ozone depletion are among the emerging issues that transcend political boundaries. Air pollution can be an ongoing feature, but can also present in acute, sometimes catastrophic, episodes. Table 7.1 shows some major air pollution disasters that have occurred during the last century.

Usually air pollution is differentiated into three broad categories: ambient, indoor, and transboundary. Ambient air refers to the air close to the ground that is in direct contact with the living world; indoor air pollution refers specifically to air within buildings, whether at the workplace or in the home; and transboundary air pollution is used to refer to pollutants that have entered the upper atmosphere and travel far from their source.

Air pollution of all three types is strongly affected by climate—precipitation, wind, temperature, radiation—and thus by changes in climate or "climate change". At the same time, air pollution is thought to be one of the major contributors to the present situation of "climate change"

This chapter deals with air pollution, its status, sources, and impacts, together with the context of the climate in Nepal and possible effects of climate change.

Status and Trends of Ambient Air Pollution in Nepal

Ambient air pollution may derive from both natural and anthropogenic sources. A typical natural process

Table 7.1: Catastrophic Air Pollution Episodes

Year	Location	Deaths and/or Injuries	Cause
1930	Meuse Valley, Belgium	63 deaths 600 sick	Pollutants released by coke ovens, steel mills, blast furnaces , zinc smelters, glass factories, and sulfuric acid plan ts were trapped in the valley.
1948	Donora, Pennsylvania	20 deaths 6,000 sick	Effluents from industries like a sulfuric acid plant, steel mill, and zinc production plant, became trapped in a valley by a temperature inversion and produced an unbreathable m ixture of fog and pollution (smog).
1952	London, England	4,000 deaths	"The London Fog" , daily temperatures below average, and industrial pollutants combined with condensation in the air to form a dense fog. Concentrations of pollutants reached very high levels causing suffocation and death.
1984	Bhopal, India	20,000 deaths 120,000 injured	Gas leakage from the Union Carbide pesticide plant caused a toxic cloud to drift over the city.

Source: Compiled from various sources by MENRIS staff

is a seasonal dust storm. Anthropogenic activities have been largely responsible for changing the air quality in urban areas. The major sources of such pollution in Nepal are vehicle and industrial emissions, and combustion of biomass and fossil fuels. Anthropogenic activities have added large amounts of macro and micro-pollutants to the atmosphere, triggering an environmental problem.

Exposure to air pollution has become an inescapable part of urban life. Millions of people in urban centers are confronted with environmental and health problems owing to harmful emissions caused mainly by motor vehicles. Given the rate at which cities are growing and the paucity of pollution control measures, air quality will continue to deteriorate.

Many studies over the last decade (MOPE/UNEP/ICIMOD 2000; CBS 1994; MOPE 1998; Pokharel 1998; Kunwar 1999; NESS 1999) have shown that ambient air in the Kathmandu Valley is heavily polluted and not in accordance with international standards, and that the air quality is deteriorating. This development has mainly been due to a rapid rise in the number of petrol and diesel vehicles plying the streets. At the same time, continued emissions from the many brick kilns, the dyeing industry, and other industries are also important contributors.

Until recently, monitoring in Kathmandu Valley was sporadic, and it was rare to have continuous series of 24 hour per day measurements. Realizing the need for continuous air quality monitoring, the Government and the Danish International Development Agency (DANIDA) agreed in March 2001 to formally initiate air quality management of Kathmandu Valley as the fifth component of the Environment Sector Programme Support (ESPS). Monitoring stations are strategically located at six places in the Valley (Figure 7.1). The pollutants measured are total suspended particles (TSP) and particulate matter of 10 micrometers (μm) or less in diameter (PM10). Currently, PM2.5 (at some stations only), nitrogen dioxide (NO_2), and benzene are also monitored on a regular basis. Analysis of the ESPS data (MOPE 2004) indicates that the major problem is a high level of suspended particulate matter together with increasing levels of NO_2 and sulfur dioxide (SO_2).

Figure 7.1: Environment Sector Program Support (ESPS) Monitoring Stations

1. Putalisadak (Urban Traffic); 2. Thamel (Urban Traffic, Residential); 3. Patan (Urban Traffic); 4. Bhaktapur (Urban Background); 5. Kirtipur (Urban Background); 6. Matsyagoan (Valley Background)

Source: MOEST (undated)

Particulate Matter

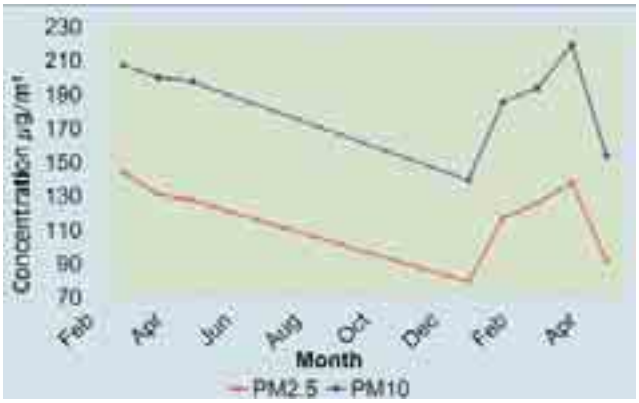
Particulate matter is the general term used for the mixture of solid particles and liquid droplets suspended in the air. These particles originate from stationary and mobile anthropogenic sources as well as from natural sources. Particulate matter is divided into two classes, primary and secondary. Primary particles are released directly into the atmosphere. Secondary particles are formed in the atmosphere as a result of reactions that involve gases.

Particulate matter is a serious problem in Kathmandu Valley. From a diesel vehicle's black puff of smoke to the haze that obscures the view of the beautiful Himalayas, particle pollution affects all residents. The complex pollution is present year round, causing health problems to the city dwellers. These particles come in many shapes and sizes and can be made up of hundreds of different chemicals. Some particles such as dust, dirt, and soot are large enough to be seen with the naked eye.

Particulate matter is generally classified according to size. Inhalable PM10 is the portion of the total air particulate matter that is 10 μm or less in diameter. Most particles with diameters greater than 10 μm will be caught in the nose and throat, never reaching the lungs. Particles between 2.5 and 10 μm will be caught by cilia lining the walls of the bronchial tubes; the cilia move the particles up and out of the lungs. Respirable particles (PM2.5) are 2.5 μm or smaller in diameter and can penetrate deeper into the air sacs.

According to the measurements done by ESPS (MOPE 2003), the average PM10 value lies between 30 and 295 micrograms per cubic meter ($\mu g/m^3$) in the core areas and 23 and 130 $\mu g/m^3$ in the sub-core and outskirts of the valley. During the dry winter periods, the PM10 values shoot up, while in the rainy season pollutants are washed from the air thus tending to lower airborne pollution (Figures 7.2 and 7.3). Apart from this seasonal variation, pollution levels peak at places where traffic density is high. Measurements for PM2.5 in Bhaktapur showed that more than 60% of PM10 is PM2.5 (Figure 7.2). This further indicates the health threat.

Figure 7.2: Concentration of PM2.5 and PM10 in Kathmandu (2003/04)



PM2.5 = particulate matter of diameter 2.5 microns or less
PM10 = particulate matter of diameter 10 microns or less
Data source: MOPE (2004)

Nitrogen Dioxide and Sulfur Dioxide

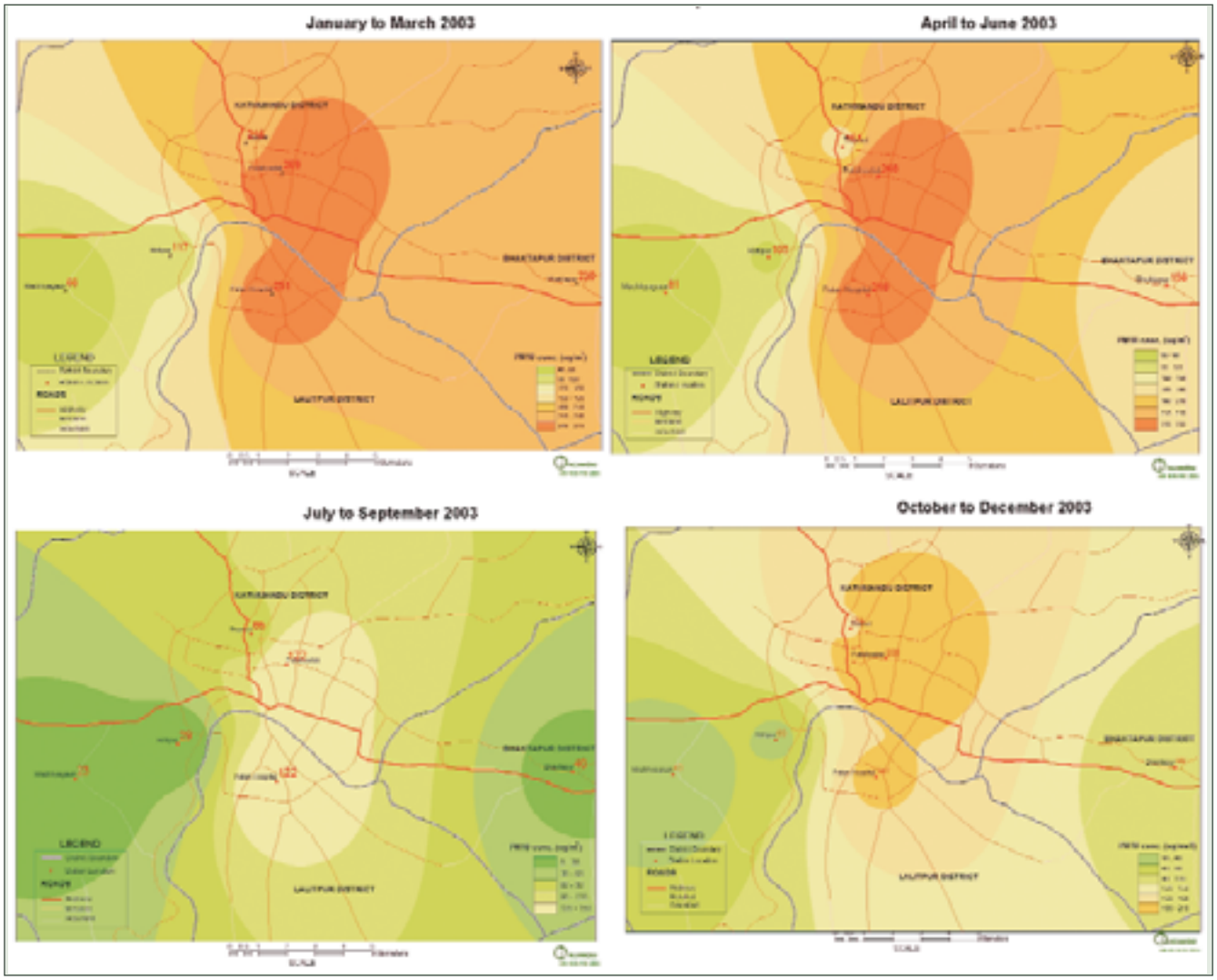
Nitrogen oxides (NO_x) form when fuel is burned at high temperatures, as in a combustion process. The primary man-made sources of NO_x are motor vehicles, electric utilities, and other industrial, commercial, and residential sources that burn fuels. Sulfur gases can be formed when fuel containing sulfur, such as coal and oil, is burned; when gasoline is refined from oil; or metals are extracted from ore. SO_2 dissolves in water vapor to form acid, and interacts with other gases and particles in the air to form sulfates and other products that can harm people and the environment. The pollutants formed from SO_2 and NO_2 can be transported over long distances and deposited far from their point of origin.

Regular monitoring of NO_2 by passive samplers has been conducted by the ESPS project since 2004 (Figure 7.4). Prior to this, only sporadic measurements were done by various organizations. Devkota in 1993 measured a 24-hour NO_2 concentration of 18 $\mu g/m^3$ for a regional background site in Kirtipur with the highest concentration (38 $\mu g/m^3$) being recorded at the Himal Cement Company site (Devkota 1993). The Society for Legal and Environmental Analysis and Development Research (LEADERS Nepal) measured 24-hour average NO_2 concentrations in different locations within the Valley in June 1998 and found they varied from 0.02 parts per million (ppm) to 0.04 ppm with an average of 0.027 ppm (LEADERS 1999). The results from ESPS show that though the values are all below the WHO guidelines, there is an increasing trend for NO_2. The NO_2 also peaks during the dry season and where the traffic density is high. Monitoring of SO_2 was done for 3 months (November and December 2003 and January 2004). The highest value was recorded in Bhaktapur (70 $\mu g/m^3$), where most of the brick kilns are located (Figure 7.5). Appendix 7.1 summarizes the WHO guideline values.

Others

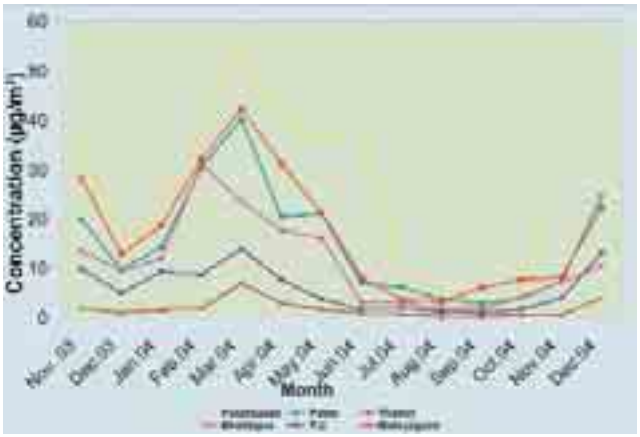
In 1993, the Environment and Public Health Organization (ENPHO) measured the average 24-hour lead concentration in the Valley and found an average value of 0.32 $\mu g/m^3$, with a range from 0.18 $\mu g/m^3$ to 0.53 $\mu g/m^3$ (ENPHO 1993). Due to the phase-out of leaded gasoline it was assumed that the lead concentration would decrease. Since 26 December 1999, only unleaded gasoline has been distributed in Nepal. However, a recent study (Chhetri et al.

Figure 7.3: Average Air Quality, January to December 2003



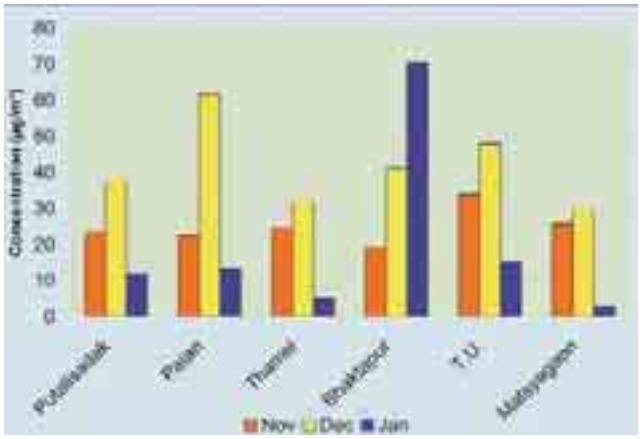
Source: Data MOPE (2003); basemap:ICIMOD (1996)

Figure 7.4: NO_2 values in the Kathmandu Valley



$\mu g/m^3$ = microgram per cubic meter, NO_2 = nitrogen dioxide
Data source: MOPE (2004)

Figure 7.5: SO_2 values at different sites in Kathmandu



$\mu g/m^3$ = microgram per cubic meter, SO_2 = Sulfur dioxide
Data source: MOPE (2004)

undated) revealed that lead is still present in Kathmandu's air despite the introduction of unleaded petrol. Lichens were transplanted to various places in Kathmandu to act as bioindicators. The highest concentrations of lead were found in dense traffic areas like Tripureshwor, Ratnapark, Bhadrakali, Gaushala, and Kalanki. The concentration of lead in transplanted lichen species ranged from 20 to 27 mg/kg.

The threat of benzene is now of concern also since the replacement of leaded petrol. Benzene is used in gasoline instead of lead to boost the octane. The octane number, which measures the anti-knock characteristics of fuel, is an important performance criterion for fuel. Internationally, most countries have ensured that there should be minimum levels of benzene in gasoline, generally less than 1%. However, fuel quality data from Nepal Oil Corporation show levels as high as 3–5% benzene found in gasoline samples in Nepal.

A three-week study conducted by the ESPS and the then Ministry of Population and Environment (MOPE) during January and February 2002 at seven locations in Kathmandu found weekly averages of ambient benzene concentrations as high as 77 $\mu g/m^3$ in Putalisadak, known as a high traffic area, but very low concentrations at Matsyagaon, a village located at the edge of the south-eastern part of Kathmandu Valley, about 150m above the valley floor (Figure 7.6). Other high traffic zones at Chabahil, Paknajol, and Patan had values of 44 $\mu g/m^3$, 30.3 $\mu g/m^3$, and 23.3 $\mu g/m^3$, respectively.

In November 2003, Bossi collected two samples of total PAH (polyaromatic hydrocarbons) from five different monitoring stations in Kathmandu and analyzed them in Denmark. Total PAH is the sum of all PAHs analyzed, which in this case included acenaphthene, fluorine, phenanthrene, fluoranthene, anthracene, 2-methylphenathrene, chrysene, benz(a)anthracene, benzo(a)fluoranthene, pyrene, benzo(a)pyrene, benzo(e) pyrene, pyrylene, indeno(1,2,3-cd) pyrene, benzo(ghi)perylene and dibenzo(a,h)anthracene). The samples taken from sites at Patan Hospital, Putalisadak, Thamel, and Bhaktapur had PAH concentrations of 2.32, 3.16, 3.23, and 4.30 $\mu g/m^3$ respectively—three times higher than the European Union recommended level (1 $\mu g/m^3$). The only place where the concentration was below this level was in Matsyagaon.

Bossi also measured PAH levels on September 18, 2003, which was a Nepal Bandh (enforced closure or "strike") day when there were very few vehicles on the streets. The level of PAH was about one-fifth of the level recorded during a normal weekday in November (Figure 7.7). This indicates clearly that vehicles are the main source of the pollution.

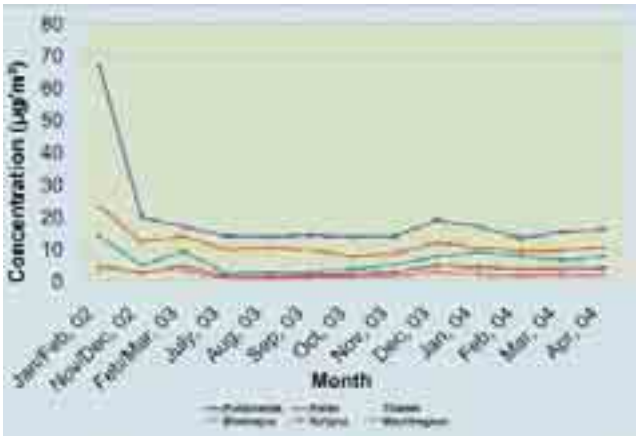
As a result of the high concentration of benzene in petrol, the ambient concentration of benzene in Kathmandu's air is at dangerous levels. Benzene, a known carcinogen, causes leukemia among others. Therefore in the interest of the health of Kathmandu's residents it has become urgent to address the problem of benzene in air.

Indoor Air Quality

The use of biomass fuels such as wood, dung, agricultural waste, and charcoal as cooking and heating fuel is the principle cause of indoor air pollution in the rural areas of Nepal. Poverty is one of the main barriers to the adoption of cleaner fuels, and the slow pace of development implies that biofuels will continue to be used by the poor. Limited ventilation increases exposure in poor households, particularly for women and young children as they spend long periods of time indoors.

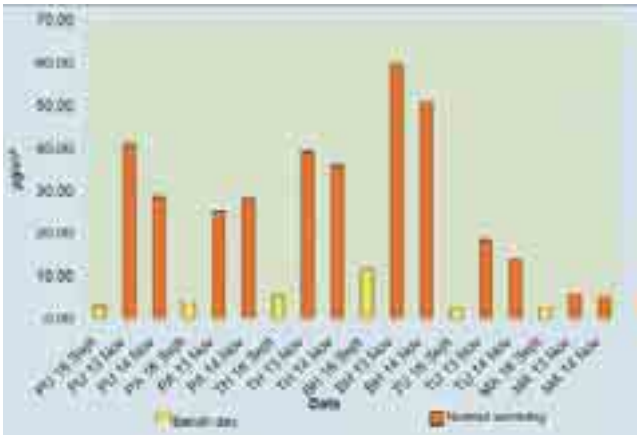
The smoke from biomass fuels is a complex mixture of aerosols containing significant amounts of carbon monoxide (CO), suspended particulate

Figure 7.6: Benzene Concentration in Kathmandu Valley



$\mu g/m^3$ = microgram per cubic meter
Source: MOPE (2004)

Figure 7.7: Polyaromatic Hydrocarbons (PAH) Level



$\mu g/m^3$ = microgram per cubic meter
Source: MOEST (undated)

matter, hydrocarbons, and NO_x (Naeher et al. 2005). Exposure to indoor air pollution carries severe health threats. Exposure to the smoke from a day's cooking is equivalent to smoking two packets of cigarettes (Warwick et al. 2004), directly affecting lungs and chest and posing risks for chronic respiratory disorders, acute respiratory infections (ARI), including pneumonia and bronchitis, chronic obstructive pulmonary disease (COPD), lung cancer, and other problems.

Pandey et al. (1987) identified the highest rates of chronic bronchitis in Jumla. After many years of study, the Nepal Health Research Council (NHRC 2004) found that the prevalence of ARI among children aged below 5 was 38% (11 of 29 examined). Comparing ARI by binary fuel types, children with unprocessed fuel in the kitchen had a higher prevalence (59%, 10 of 17) as compared with children with processed fuel in the kitchen (33%, 1 of 3). Bates et al. (2005) confirmed that the use of solid fuel in unflued indoor stoves is associated with an increased risk of cataracts in women, who do the cooking. According to a comparative study conducted by Reid et al. (1986) also cited by Raut (undated), the mean personal exposure to TSP in traditional (*agena*) cooking stoves and improved stoves is 3.92 and 1.13 mg/m^3, respectively. Similarly, mean personal exposure to CO in traditional stoves and improved stoves was found to be 380 and 67 ppm, respectively. This implies that improved cooking stoves reduce indoor TSP concentration by around 70% and CO concentration by 80% compared with traditional stoves. Lack of awareness, willingness to invest, and ability to pay for the new technology are issues preventing a switch to this cleaner technology.

The World Summit on Sustainable Development in Johannesburg acknowledged that the vicious cycle of energy and poverty needs to be broken to achieve the Millennium Development Goals for reducing world poverty. A lack of access to clean and affordable energy can, and should, be considered a core dimension of poverty.

Improvements in stoves and fuels, along with better-ventilated rooms, are the main tools for controlling the problem of indoor air pollution.

R. Shrestha

Woman with Baby Cooking

Transboundary Air Pollution

Transboundary air pollution refers to cross-boundary pollutants generated in one country and felt in others. Such pollution can survive for days or even years and can be transported hundreds or thousands of miles before affecting the air, soils, rivers, lakes, and food at the distant site. Transboundary air pollutants cause a number of different problems, e.g., formation of ground level ozone that is hazardous to health, formation of acid rain that can damage buildings and sensitive ecosystems, and other effects that are toxic to human health and the environment.

The main sources of this pollution are emissions of SO_2, NO_x, volatile organic compounds, and various toxic materials such as heavy metals and persistent organic pollutants from transport and energy usage. The main effects are acidification of water and soil, summer smog caused by tropospheric ozone, and eutrophication of soils and waters. SO_2, NO_x, and NH_3 cause acidification and eutrophication. Volatile organic compounds and NO_x deplete ozone, and heavy metals and persistent organic pollutants contribute to bioaccumulation of toxic substances.

The major weather patterns in Asia are conducive to transboundary transport of air

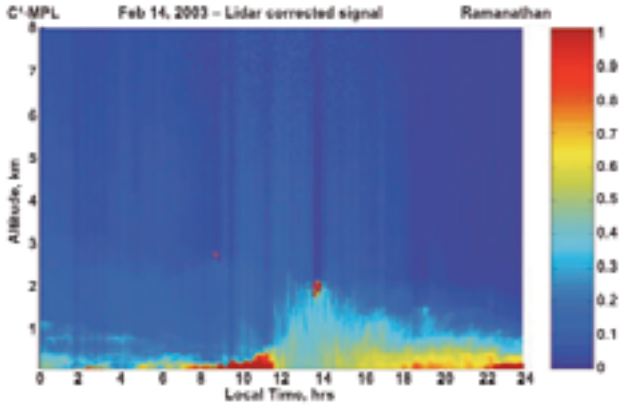
V. Ramanathan

Haze – *Haze over Phaplu: both photographs taken from the same location, one viewing north (top) and the other south (bottom), from a flight altitude of about 3 km above the ground in March 2001. During the dry season, the brown sky seen over Nepal is typical of many areas of South Asia.*

pollutants from land to sea and the reverse in summer (UNEP 2002) Pollutants can thus be carried from country to country in the region and collective cooperation and effort are required. The Malé Declaration on Control and Prevention of Air Pollution and its likely Transboundary Effects for South Asia, and the Atmospheric Brown Cloud Project are examples of regional cooperation in addressing these problems.

Studies carried out in Nepal are at too early a stage for any conclusive results. However, a light detection and ranging (LIDAR) observation from February 2003 showed long-range transport of pollution (Figure 7.8). The layer at 2600 meters above ground level is most likely due to dry convective lifting of pollutants at distant sources and subsequent horizontal upper air long-range transport (Ramana et al. 2004).

Figure 7.8: LIDAR Observation



Source: Ramana et al. (2004)

Sources of Emissions

Transportation

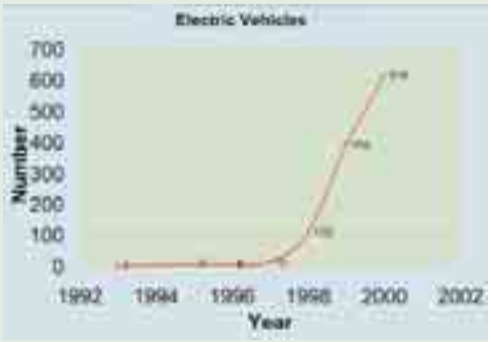
Nepal's transport sector is dominated by road transportation due to the country's land-locked geographical position. Apart from roads, air transport is the only modern form of transportation. Airplanes reach many remote destinations in the kingdom where roads do not or only barely exist. High currents and high slopes make water transportation impossible along the rivers. The only train track is a 52 km stretch from the border with India.

Much of the urban air pollution in Nepal, particularly in Kathmandu Valley, is caused by vehicular emissions. The problem is magnified by the narrow streets, poor traffic management, poor vehicle maintenance, and the use of adulterated, substandard fuel (Joshi 1993).

There were 418,910 transport vehicles registered in Nepal in March 2004 (Figure 7.9), an increase of 6.7% within the preceding eight-month period. Of these, 249,282 vehicles were registered in the Bagmati zone, an 11.2% increase from the previous year. The total road length in March 2004 was 16,042 km, giving an average of 26 vehicles per

Success of Safa Tempos

Kathmandu suffers from severe air pollution due to vehicle emissions and is ideal for the introduction of zero emission electrical vehicles. With a population of approximately 1.5 million people, the city occupies an area roughly 12 km wide. Thus, distances traveled are quite short. Speeds seldom exceed 40 km per hour and are generally below 30 km.



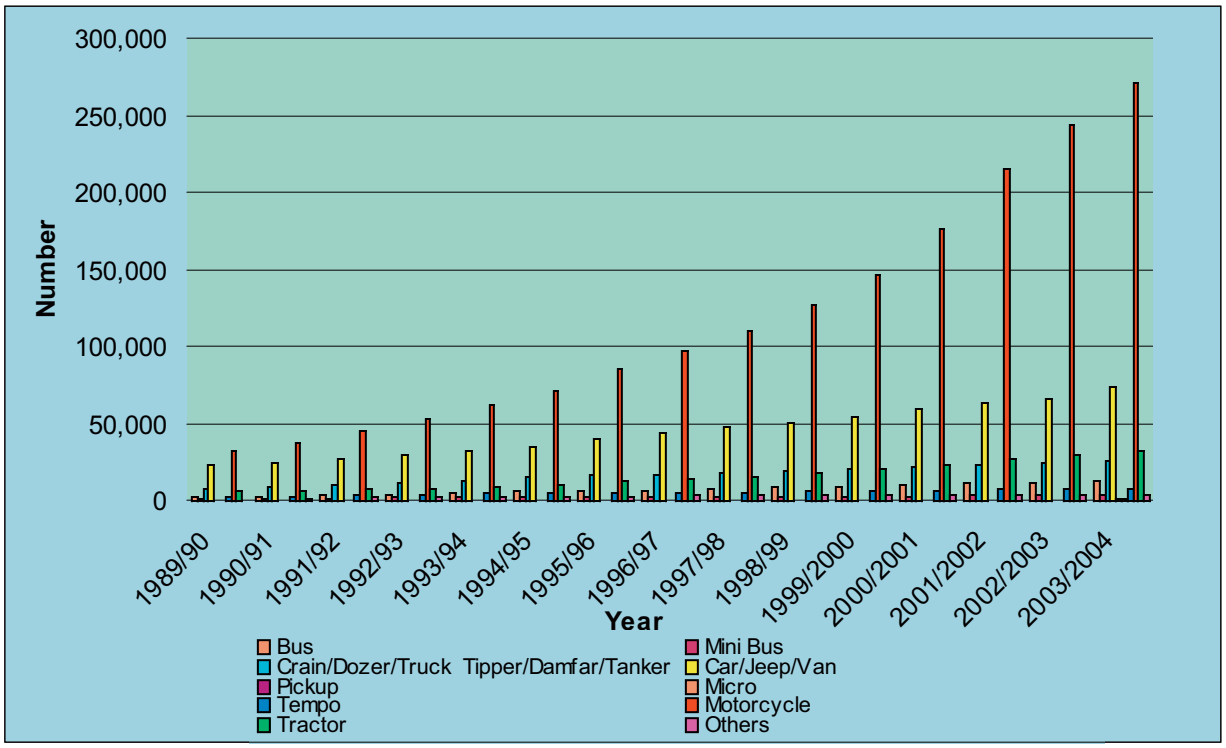
The Global Resources Institute initiated the first phase of an electric vehicle program for Kathmandu in September 1993 with the conversion of a diesel three-wheeler to electric power. Following extensive tests on the initial vehicle to optimize the drive system, seven new three-wheelers were built and the first converted vehicle was retrofitted with the new drive system. In August 1995, these eight vehicles were placed into service as a six-month demonstration project with a company providing public transportation. On February 20, 1996, these electric "tempos" — Safa tempos—were passed from the Institute to the owners of the Nepal Electric Vehicle Industry. Two other private companies have also been registered to operate electric public transportation networks.

Since mid-September 1999, 3-wheeler diesel tempos, popularly known as Vikram tempos, have been banned in the Valley. In their place, the Government made provisions to import petrol microbuses that meet Euro-1 standards. New registration of 3-wheeler diesel tempos was also banned. This decision dramatically increased the fleet of battery charged and liquefied petroleum gas (LPG) 3-wheelers to fill the gap in meeting the public transport demand. Further, the Government reduced import duties on components for local assembly of electric three-wheelers from 60% to 5% and on fully assembled electric vehicles of all types from 150% to 10%.

At present (early 2005) there are 450 Safa tempos in operation. Public response has been overwhelmingly favorable, the only criticism being the rise in the electricity tariff, which will eventually add to the cost of the battery recharge.

Source: Roy et al. (2001) and DOTM (2005)

Figure: 7.9: Vehicle Registered in Nepal



Source: DOTM (2005)

km of road in the country as a whole and 96 vehicles per km of road in the Bagmati zone. Consumption of petrol has risen continuously since 1998 with the vehicle fleet increase, but the consumption of diesel has fluctuated (Table 7.2). The estimated consumption figures for the Valley were 80% petrol and 27% diesel. Shrestha and Malla (1996) showed the total annual emission load from the transportation sector at 12,422 tons—an updated study would be extremely useful. The Valley is especially vulnerable to air pollution due to its bowl-shaped topography.

Industry

The manufacturing sector is relatively small in Nepal. Its share in national gross domestic product (GDP) is only 9.5% (CBS 2003). In the 2001/02 census (CBS 2002), Nepal had 3,230 industries, of which 1,498 were in the central development region and 846 in Kathmandu Valley. An emission inventory was conducted in the Kathmandu Valley in 1993 (Shrestha and Malla 1996). At that time the industrial sector in the Valley emitted 3,574 tons of TSP, 5,220 tons of CO, 1,492 tons of hydrocarbon, 628 tons of NO_x, and 1,349 tons of SO_2 per year.

After closure of the Himal Cement Factory, a major polluter, the brick industries located south of the Valley center are assumed to be the major air polluting industries, particularly with respect to dust emission. There are about 125 brick kilns operating in Kathmandu Valley, of which 113 are bull's trench type, 9 are clamp kiln type, and 3 Hoffmann kilns. As the manufacturing process in bull's trench and clamp kilns is very poor and inefficient, the amount of smoke emitted from these kilns is very high. A study carried out by Tuladhar and Raut (2002) near the vicinity of brick kilns (Tikathali village development committee (VDC), Lalitpur) showed that during the operation of the kilns the level of pollution was three times higher than on other days (Figure 7.10). Thanks to a cleaner technology initiative from an ESPS project initiating use of a new technology, suspended particulate matter was reduced to about 950 $\mu g/m^3$ from 2,000 $\mu g/m^3$ from the kiln. Brick production using the new technology is costlier, as it requires a large initial investment. However, it is environmentally friendly. The main advantages in the new technology are energy cost savings and quality production, which eventually pays for the initial investment by increasing production of grade "A" bricks to over 90% from around 40% with the older technology.

Household

Biomass energy accounts for about 15% of the world's primary energy consumption, about 38% of the primary energy consumption in developing countries, and more than 90% of the total rural energy supplies in developing countries where large quantities of biomass fuels are used for cooking

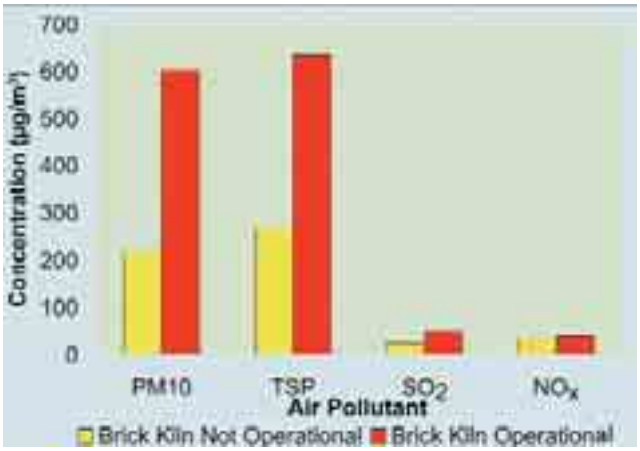
Table 7.2: Consumption of Petroleum Products

Main Item of Petroleum	Unit	1988/89	1989/90	1990/91	1991/91	1992/93	1993/94	1994/95	1995/96
Petrol	'000 liters	17,340	14,708	17,241	26,780	29,910	31,056	34,942	41,191
Diesel	'000 liters	75,356	103,273	106,438	166,552	179,900	196,047	227,226	250,504
Kerosene	'000 liters	63,246	92,672	75,939	122,458	149,237	162,077	180,536	208,720
Light Diesel Oil	'000 liters		9,327	16,541	2,542	1,530	–	4,191	4,375
Furnace Oil	'000 liters	–	–	–	11,062	20,222	27,319	31,567	18,449
Air Fuel	'000 liters	–	–	–	24,836	29,210	30,250	37,536	40,621
LPG	million tons	–	–	–	–	–	–	–	18,400

Main Item of Petroleum	Unit	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04[a]
Petrol	'000 liters	44,889	46,939	49,994	55,589	59,245	63,578	68,482	46,058
Diesel	'000 liters	257,235	300,604	315,780	310,561	326,060	287,657	301,672	181,818
Kerosene	'000 liters	243,005	282,026	294,982	331,120	316,381	390,113	351,696	208,033
Light Diesel Oil	'000 liters	2,017	967	547	4,005	3,418	2,413	610	556
Furnace Oil	'000 liters	16,858	27,776	33,860	26,876	20,999	18,255	14,502	6,405
Air Fuel	'000 liters	47,688	51,412	55,549	56,849	63,130	47,274	53,546	44,653
LPG	million tons	21,824	22,361	25,019	30,627	40,102	48,757	56,079	43,871

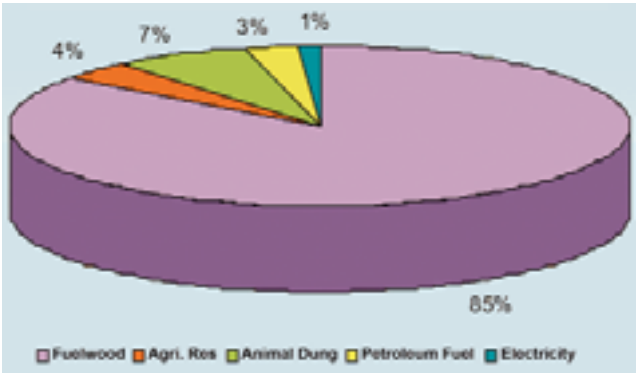
– = not available, LPG = liquefied petroleum gas
[a] First 9 months of the Nepali year, approximately April –December 2003 .
Source: MOF (2004)

Figure 7.10: Pollutants Monitored at Tikathali



$\mu g/m^3$ = microgram per cubic meter
Source: Tuladhar and Raut (2002)

Figure: 7.11: Total Energy Consumption by Residential Sector



Source: WECS (1999)

(Bhattacharya undated). Deforestation and desertification are the most serious consequences of reliance on biomass fuels. Use of crop and animal residues for fuel deprives the soil of recycled nutrients and reduces crop yields along with the land's capacity to support livestock. Biomass fuels are the most common fuels used in rural areas of the Terai and the Hills. Use of coal and kerosene in rural areas is limited to relatively well-to-do families. In cities, liquefied petroleum gas is also used extensively. Figure 7.11 shows the amount of energy consumption by the residential sector by fuel type.

There are no estimates of emissions from domestic fuel use available for the entire country, although a few research studies have been conducted in Kathmandu Valley. Shrestha and Malla (1996) estimated that in 1993 14,246 tons of air pollutants were emitted each year from domestic sector energy use in Kathmandu Valley.

Household equipment is also a source of a particular group of "ozone depleting substances," chemicals that enter the air, travel to the upper atmosphere, and are instrumental in destroying the upper level ozone layer that shields the earth from harmful radiation. The people living in Nepal's urban areas are more used to modern amenities than those in rural areas. More and more urban inhabitants are able to enjoy a comfortable life with modern amenities such as refrigerators and air conditioning. A survey carried out by the Nepal Bureau of Standards and Metrology (NBSM 1999) identified chlorofluorocarbons (CFC-12) and hydro-

B.B. Pradhan

Brick Kiln

chlorofluorocarbons (HCFC–22) as ozone depleting substances (ODS). The consumption of these two substances was 30 tons and 23 tons, respectively (NBSM and UNEP undated). The country does not produce any ODS itself—all these substances are imported. The annual per capita ODS consumption in Nepal in 1999 was 0.0013 kg. The regulatory measures developed to address the problem are described in a later section.

Natural Sources of Air Pollution

Natural sources of air pollution include such things as volcanic eruption, forest fires, pollens from vegetation, and salt particles from sea spray. Forest fires occur annually in all the major physiographic and climatic regions of Nepal, including the Terai and Bhabar, the Siwaliks or the inner Terai, the Middle Mountains, and the High Mountains, although reliable statistics are not available. Pollen grains are another natural contaminant associated with health problems such as allergies. Many people suffer from asthma or hay fever although the symptoms disappear at the end of the pollen season—some even develop bronchitis, bronchial asthma, and dermatitis. Suspended dust from roads is also highly visible in Nepal, adding to the suspended particle load in the air.

Impact of Air Pollution

Although air pollution has become a visible environmental problem in the last decade, only limited data are available to evaluate its magnitude and impact.

The health impact of indoor and outdoor air pollution can be assessed by the increase in the number of patients suffering from diseases related to air pollution. Health effects range from minor irritation of eyes and the upper respiratory system to chronic respiratory disease, heart disease, lung cancer, and death. Air pollution has been shown to cause acute respiratory infections in children and chronic bronchitis in adults. It has also been shown to worsen the condition of people with pre-existing heart or lung disease. Among asthmatics, air pollution has been shown to aggravate the frequency and severity of attacks. Both short-term and long-term exposures have also been linked to premature mortality and reduced life expectancy (Mishra 2003).

The health impact of air pollution depends on the pollutant type, its concentration in the air, length of exposure, other pollutants in the air, and individual susceptibility. Different people are affected by air pollution in different ways. Poor people, undernourished people, the very young and very old, and people with pre-existing respiratory disease and other ill health are more at risk (Mishra 2003).

Exposure to particles can lead to a variety of serious health problems. Fine particles pose the greatest problems because they can get deep into the lungs and some fine particles into the bloodstream. Long-term exposure to particulate matter shows decreased lung function, chronic bronchitis, premature deaths, and heart attacks. No long-term epidemiological studies have been conducted in Nepal, but a few studies have conducted preliminary medical examinations of a group of exposed people or used dose-response relationships developed elsewhere.

According to the data published by the then Ministry of Health (now Ministry of Health and Population), among patients visiting the major hospital (DOHS 2003), ARI ranks as the third-highest cause of morbidity in Nepal after diarrhea, affecting 3.13% of the total population (this document, Chapter 2, Table 2.18). Chronic bronchitis falls at the eighth position.

Pandey et al. (1987) examined 240 rural children under 2 years of age for 6 months and found a significant relationship between the number of hours spent near the fire (as reported by the mother) and the incidence of moderate and severe cases of ARI. The study suggested that indoor air pollution is an important risk factor for ARI. A 1971 review of the cases of discharges from ten hospitals with a combined capacity of 265 beds revealed that ARI accounted for 32% of mortality for infants less than 1 year and 11% for children aged 1–4 (WINROCK 2004).

COPD is another major risk, especially among women, and has been strongly associated with smoke exposure from cooking on open biomass stoves. In rural Nepal, nearly 15% of non-smoking women 20 years and older had chronic bronchitis (WINROCK 2004), a high rate for non-smokers.

Similar cases are observed in the urban centers where outdoor air pollution is soaring. A study by the

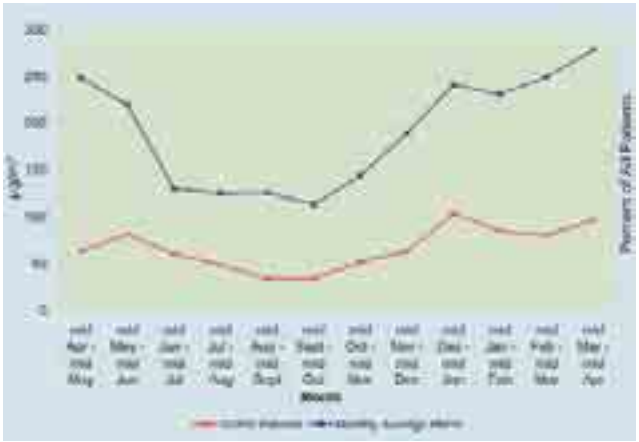
World Bank in 1990 estimated impacts on mortality and morbidity due to PM10 levels. The study estimated that Kathmandu's PM10 levels resulted in 84 cases of excess mortality, 506 cases of chronic bronchitis, 4,847 cases of bronchitis in children, and 18,863 asthma attacks per year. Overall, Kathmandu's residents experienced over 1.5 million respiratory symptom days per year (Shah and Nagpal 1997).

An analysis of the records of 369 COPD patients and 315 control patients admitted to Patan Hospital from April 1992 to April 1994 showed that the odds of having COPD are 1.96 times higher for Kathmandu Valley residents compared with outside residents. The study also stated that over the past decade the proportion of COPD patients had increased more than fourfold and that COPD was the number one killer of adult patients in the hospital (CEN and ENPHO 2003).

The records from three major hospitals in Kathmandu indicate that the number of COPD patients admitted to hospitals, as well as the number of COPD patients as a percentage of all patients, has increased significantly in the last ten years. Hospital records also indicate that the number of COPD patients is highest in the dry winter months, when air pollution in Kathmandu is at its peak (Figure 7.12). Vehicular pollution and suspended dust from poorly maintained roads are the major causes for the poor air quality in urban centers.

Another observable impact is on visibility. Atmospheric data obtained from Kathmandu airport from 1970 onwards shows a substantial decrease in visibility in the Valley since 1980. The trend towards reduced visibility in the Valley has been quite dramatic for the months November–March, and particularly for December–February. The number of days with good visibility (>8,000 m) at 11:45 am decreased in the winter months from more than 25 days/month in 1970 to 5 days/month in 1992. By 1997, the number of days per month in December–February with good visibility at noon approached zero (Sapkota et al. 1997).

Figure 7.12: Air Pollution Level in Kathmandu and Incidence of Chronic Destructive Pulmonary Disease (COPD) Patients as a Percentage of All Patients



Data Source: Limbu (2005)

The impacts of air pollution are felt not only on health but also on vegetation and in corrosion damage to buildings and monuments. Air pollution can inflict significant damage on local vegetation. The information collated by Regional Air Pollution in Developing Countries during the initial phase of the Crops and Forests Project has clearly shown that in many developing countries, and particularly in parts of Asia, crop yields and forest productivity are being severely affected by local ambient air pollutant concentrations. In the context of South Asia, there is a strong linkage between monsoon activity and agricultural productivity. In the last decade, Nepal and the Indo-Gangetic plains of India experienced severe sky overcast during winter, affecting major winter crops like potato, oilseeds, pulses, and onion. Yield reduction in 1997/98 ranged from 11% to 38% compared with the average of the preceeding 10 years. The precise reasons for this, however, are not yet clear. Frequent occurrence of cold waves and fog mixed with dust particles in the atmosphere could be the cause. Likewise, reduction of solar radiation could be the explanation. Aerosols can directly alter the hydrological cycle by suppressing evaporation and rainfall. With respect to agricultural changes, it can directly impact productivity by shading vegetation from solar radiation; and indirectly through induced changes in temperatures and the hydrological cycle (UNEP and C4 2002).

Climate and Climate Change

Nepal's Climate

The climate in Nepal varies from tropical to arctic within the 200 km span from south to north. Much of Nepal falls within the monsoon region, with regional climate variations largely being a function of elevation. National mean temperatures hover around 15°C, and increase from north to south with the exception of the mountain valleys. Average rainfall is 1,500 mm, with rainfall increasing from west to east. The northwest corner has the least rainfall, situated as it is in the rain shadow of the Himalayas. Rainfall also varies by altitude—areas over 3,000 m experience a lot of drizzle, while heavy downpours are common below 2,000 m. Although annual rainfall is abundant, its distribution is of great concern. Flooding is frequent in the monsoon season during summer, while droughts are not uncommon in certain regions in other parts of the year.

Climate Change

A region's climate is a summary of the past weather events that have occurred at that location. Climate is typically described by the statistics of a set of atmospheric and surface variables, such as temperature, precipitation, wind, humidity, cloudiness, soil moisture, sea surface temperature, and the concentration and thickness of sea ice. Statistics may be in terms of the long-term averages or other measures such as daily minimum temperature, length of the growing season, or frequency of floods. Weather, on the other hand, refers to the temperature, precipitation (rain and snow), humidity, sunshine, and wind that occur at a particular time at a specific location.

Climatologists say that our planet is getting warmer overall and that this is leading to climate change (IPCC 2001). The mean global surface temperature has increased by about 0.3 to 0.6°C since the late 19th century and by about 0.2 to 0.3°C over the last 40 years, which is the period with the most reliable data (UNEP undated). This build-up is attributed to the result of human activities, especially our use of fossil fuels in, for example, automobiles and power plants. In other words, air pollutants in the broadest sense are considered to be the main cause of climate change. The impacts of this unprecedented warming—increased floods and drought, rising sea levels, spread of deadly diseases such as malaria and dengue fever, increasing numbers of violent storms—threaten to be more severe and imminent than previously believed.

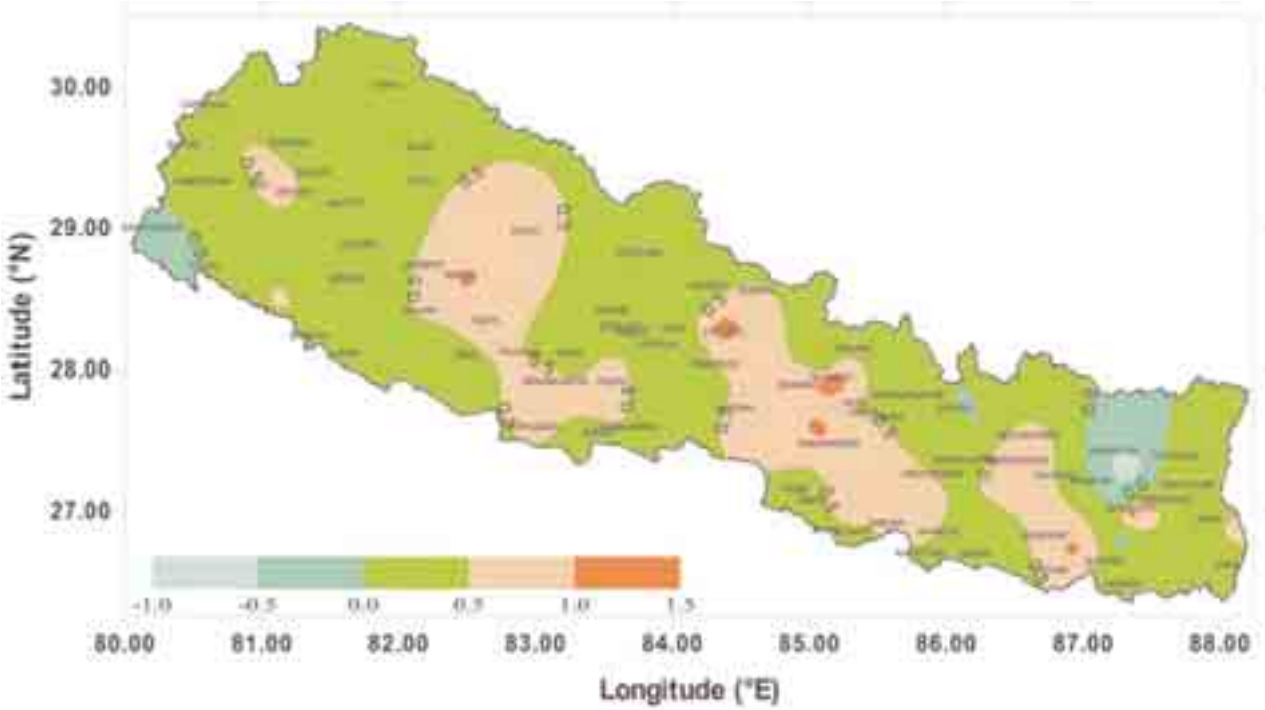
Impacts are already being felt in the Arctic, where the average annual temperature has increased approximately four times as much as average annual temperatures around the rest of the globe (CIEL 2004). Rising temperatures have caused outbreaks of insect pests such as the spruce bark beetle, which is reproducing at twice its normal rate in today's warmer climate (Anchorage Daily News 2005). Similarly, observable changes have also been felt in Nepal. Some particular aspects of climate change as they relate to Nepal are discussed below.

Climate Change in Nepal

Temperature Change

In Nepal, the elevation generally increases from south to north and is accompanied by decreasing temperatures. Temperature observations in Nepal from 1977–1994 showed a general warming trend (Shrestha et al. 1999) with significantly greater warming at higher elevations in the northern part of the country than at lower elevations in the south. This finding is reinforced by observations by Liu and Chen in 2000 on the other side of the Himalayas on the Tibetan Plateau. Significant glacier retreat as well as significant expansion of several glacial lakes has also been documented in recent decades, with an extremely high likelihood that such impacts are linked to rising temperatures. The results of a temperature trend analysis for the period 1981 to 1998 based upon data from 80 stations are shown in Figure 7.13. Except for small pockets in the eastern

Figure 7.13: Observed Mean Annual Temperature Trend (°C) per Decade for the Period [1981-1998]



Source: MOPE and UNEP (2004)

region and far western Terai, most of Nepal showed a positive trend of between 0°C and 0.5°C per decade. Agrawal et al. (2003) pointed out that the temperature differences are most pronounced during the dry winter season, and least during the height of the monsoon.

A study carried out by MOPE and the United Nations Environment Programme (UNEP) for the Initial National Communication to the Conference of the Parties of the United Nations Framework Convention on Climate Change using models (Canadian Climate Change Model ["CCCM"], Geophysical Fluid Dynamics Model ["GFD3]", and Regional Climate Model) and their projections showed a projected 2 to 4°C rise in average annual temperature over Nepal when CO_2 is doubled. The magnitude of temperature rise would be greater in western Nepal than in other regions. According to the CCCM model, winter showed the greatest increase of any season with the highest value in the far-western region (2.4°C to 5.4°C), and for all seasons, the rising gradient was from east to west, whereas in the GFD3 model it was from west to east during pre-monsoon and winter.

Precipitation Change

In Nepal, altitude affects annual rainfall and precipitation patterns. Up to about 3,000 m, annual rainfall totals increase with altitude; thereafter, annual totals decrease with increasing altitude and latitude. Eastern Nepal receives approximately 2,500 mm of rain annually, the Kathmandu area about 1,420 mm, and western Nepal about 1,000 mm (Figure 7.14).

In the prediction study conducted by MOPE and UNEP (MOPE and UNEP 2004) precipitation was found to increase for all seasons in general, with a rising gradient from west to east using the GFD3 model. The CCCM model predicted a negative gradient of precipitation from west to east during winter but followed the trend of the GFD3 model in other seasons. Trend analysis of observed precipitation between 1981 and 1998 (Figure 7.15) showed a negative trend in the monsoon, post monsoon, and annual scenarios which was more pronounced in western Nepal than in eastern Nepal. Most of the Terai belt, except in the eastern region, had a negative trend for all seasons.

Impact of Climate Change in Nepal

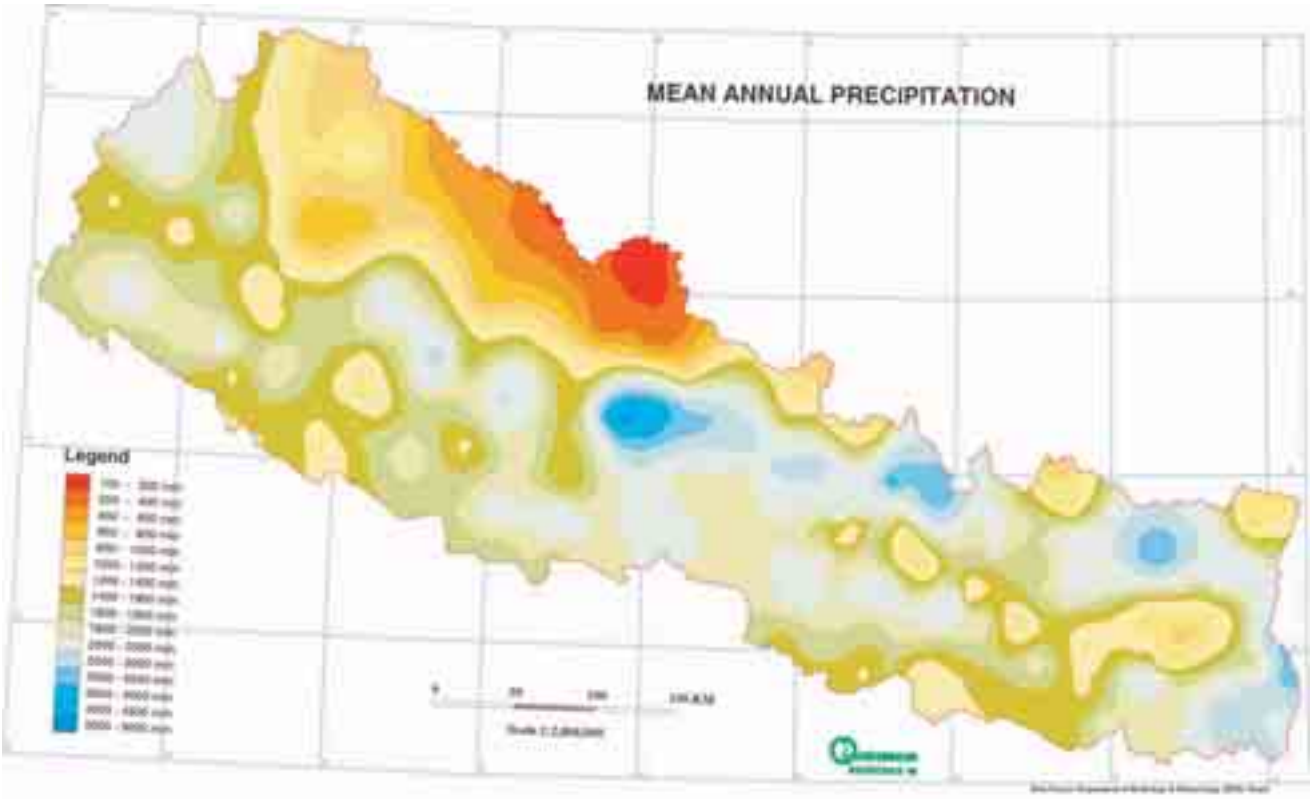
There are a number of anecdotal perceptions about Nepal's changing climate. However, further research is needed before drawing firm conclusions as to whether and how the climate is already changing.

In the Terai belt during the winter, news reports indicate that fog persists until late morning, and winter mornings are thus much colder than previous years. Winter days in Kathmandu Valley are less cold, frost is becoming rare, and the summers are warmer. The beginning of spring has become a persistent cold rain. Rain has become less predictable and dependable, both in distribution and amount. There has been more ice and less snow. These changes can have a direct influence on surface runoff, agriculture, vegetation, and people's daily lives.

One of the few measured changes is that of glacier retreat. The increase in temperature in the Himalaya and the vicinity appears to have been higher in the uplands than in the lowlands (Shrestha et al. 1999). The warming has resulted in marked retreat of the glaciers with a reduction in both area and ice volume (Agrawal et al. 2003). The glacier from which Sir Edmund Hillary and Tenzing Norgay set out to conquer Mount Everest nearly 50 years ago has retreated three miles up the mountain—presumed to be a result of climate change—as reported by a team of climbers backed by UNEP (UNEP 2002). The Himalayan glaciers are a renewable storehouse of fresh water that benefits hundreds of millions of people downstream, thus glacier retreat has long-term implications for water storage and availability. Glacier retreat can also lead to more immediate problems. As glaciers retreat, lakes can form behind the newly exposed terminal moraine. The unstable "dam" formed by the moraine can breach rapidly, leading to a sudden discharge of huge amounts of water and debris—a glacial lake outburst flood—often with catastrophic effects in terms of damage to roads, bridges, trekking trails, villages, and agricultural lands, as well as loss of human life and other infrastructure. Over the past 50 years, there have been at least 21 recorded outburst flood events that have affected Nepal. In 2001, ICIMOD and UNEP documented 27 potentially dangerous glacial lakes in Nepal (Mool et al. 2001).

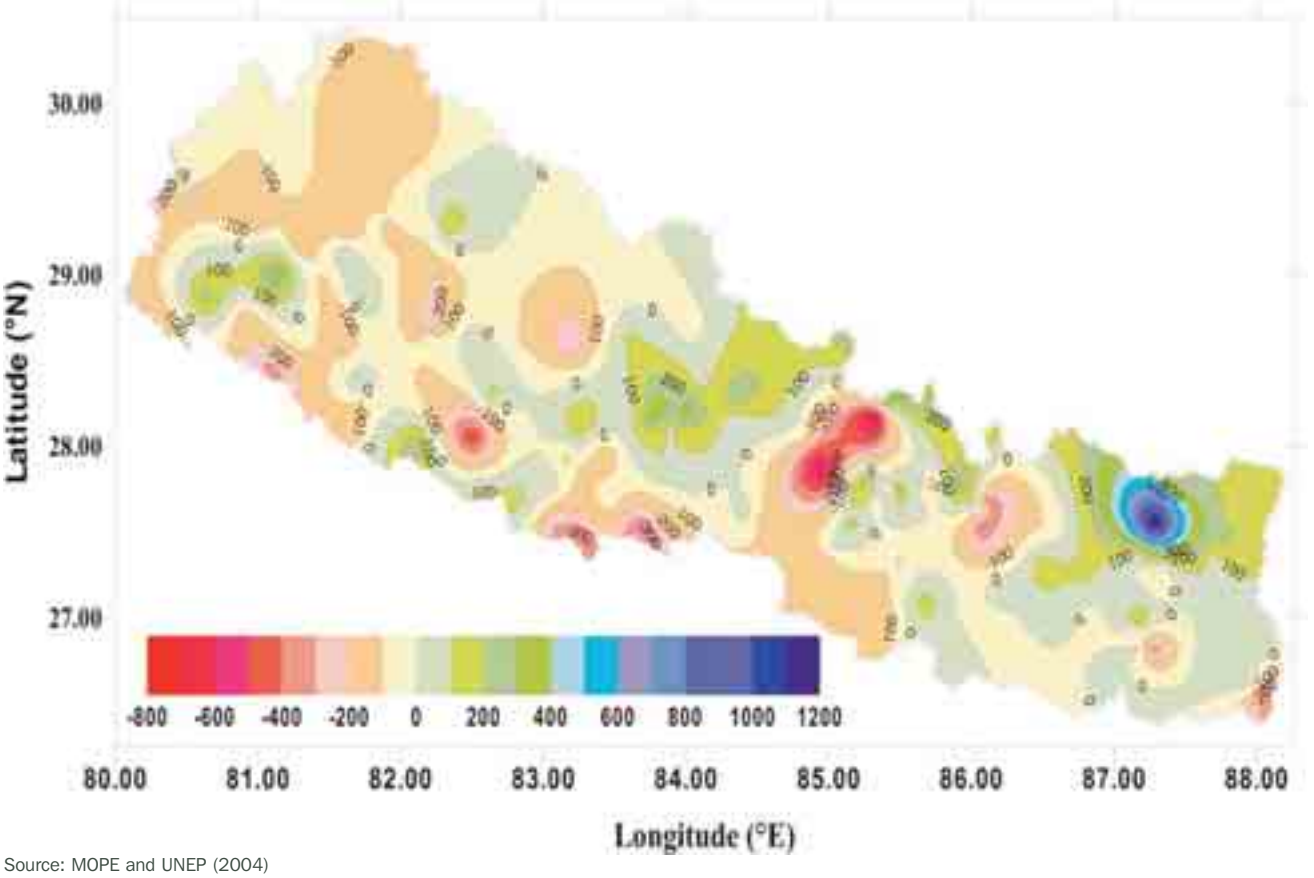
Climate change will inevitably have an impact on air pollution in the country. Rainfall markedly reduces the levels of certain pollutants in ambient air, especially particulate matter. Increased frequency of rain will reduce urban air pollution and vice versa. Equally, precipitation could set chemical processes in motion that have a negative impact. Increased wind and storms may increase the levels of transboundary pollutants, and/or increase dust levels. Raised or lowered temperatures and precipitation may impact on human activity and thus on levels of air pollutants. There are a myriad different possibilities, but as yet prediction and measurement of possible climate change in Nepal is in its infancy, and thus the possible impacts can only be guessed at.

Figure 7.14: Mean Annual Precipitation



Data Source: DHM (2003); Base map: ICIMOD (1996)

Figure 7.15: Trend of Annual Precipitation (mm) per Decade for the Period (1981-1998)



Source: MOPE and UNEP (2004)

Policy Response

Recent years have witnessed the emergence of a number of national and local responses to environmental problems in Nepal. These initiatives are described below.

Regulatory Measures

Air pollution is increasingly recognized as a serious problem in urban and peri-urban settlements. Accordingly, ambient air quality standards have been formulated (Table 7.3). Public awareness and judicial actions have also prompted policy initiatives. However, enforcement of the standards still needs to be strengthened.

The transportation sector is one of the main contributors to air pollution in urban areas. The Government has taken several measures to reduce vehicular emissions, which are described below.

Nepal introduced vehicle exhaust emission tests in 1994 following the tail-pipe standards of 65 hartridge smoke units (HSU) for diesel-operated vehicles and 3% CO for petrol-operated ones. A vehicular color rating system with respect to the exhaust emission standards was introduced. This system provides green stickers to vehicles meeting the emission standard and red stickers to vehicles failing the test. See Table 7.4 for details.

Nepal Vehicle Mass Emission Standard 2056 (2000) is the Government's major step towards reducing emissions per kilometer of travel. This standard is similar to the European Union standard, popularly known as the EURO-1 standard.

Actions undertaken include the following. Since mid-September 1999, 3-wheel diesel tempos have been banned in Kathmandu Valley, Pokhara, and Lumbini. Electric vehicles and LPG 3-wheelers have been introduced to meet the public transport demand. Lead free gasoline was introduced in Kathmandu Valley in July 1997, and since December 26, 1999 only unleaded gasoline has been distributed in Nepal. The Government resolved on November 10, 1999 to ban movement of vehicles older than 20 years and all three wheelers and two-stroke engines from the Valley beginning middle of November 2001. But this decision was not implemented by the Government due to protest by many vehicle owners. The Government has already banned the registration of new two-stroke engine vehicles in Kathmandu.

Measures have been taken to ban the polluting bull's trench kilns from Kathmandu Valley, and registration of these kilns has stopped. The Government closed the Himal Cement Factory following local public complaints. Pollution-prone industries must now obtain licenses prior to establishment or expansion. Licenses for such industries will be given only after ensuring that they have no adverse impact on the environment. Industrial pollution control regulations have been drafted and environmental impact assessment (EIA) guidelines have been prepared for each industrial sector.

Regulatory measures have also been introduced to address the problem of ozone depleting substances (ODS). Nepal is a signatory to the Montreal Protocol, and the Nepal Bureau of Standards and Metrology has been designated to implement it. The Gazette Notification issued on September 2000 determines the annual consumption quotas and established an annual phase out of chlofluorocarbons, hydrochloro-fluorocarbons, halons, and other ODS. Similarly, the ODS Consumption (Control) Regulations 2001, requires all ODS importers to obtain licenses and forbids re-export of imported substances to other countries. The joint phase-out rate of CFC 11/12 will be 10% a year, to reach zero by 2010. Because all these substances are imported from other countries, it is feasible to keep track of the amount of ODS being consumed and to achieve this goal by 2010.

Economic Instruments

Financial incentives in the form of tax concessions and subsidies are common practices as economic instruments. The Department of Transport Management charges tax according to the date of vehicle manufacture, with a higher tax levied on vehicles older than 20 years.

Similarly, a levy of NRs 0.50 per liter was introduced on the sale of petrol and diesel. The amount collected goes to the Kathmandu Valley Development Fund for pollution control, environment protection, and improvement of roads, sewerage system, and water supply. However, this still needs to be implemented (personal communication, Ministry of Environment, Science and Technology [MOEST]).

Other initiatives include a subsidy on alternative energy, as follows: solar photovoltaic—50% subsidy; PV pumping system—75% subsidy; solar dryer—50% subsidy (1998).

Technological Improvements

Environmental considerations have started to influence industrial establishments, requiring them to limit their emissions and wastes. Due to public pressure from nearby residential areas and from consumers, industries are gradually being required to utilize environmentally friendly processes (ESPS undated). ESPS has started one such activity in Hetauda Industrial District.

Table 7.3: National Ambient Air Quality Standards for Nepal

Parameter	Units	Averaging Time	Concentration in Ambient Air, maximum	Test Methods
TSP (total suspended particulates)	$\mu g/m^3$	Annual		
		24-hours[a]	230	High volume sampling
PM10	$\mu g/m^3$	Annual		
		24-hours[a]	120	Low volume sampling
Sulfur Dioxide	$\mu g/m^3$	Annual	50	Diffusive sampling based on weekly averages
		24-hours[b]	70	To be determined before 2005.
Nitrogen Dioxide	$\mu g/m^3$	Annual	40	Diffusive sampling based on weekly averages
		24-hours[b]	80	To be determined before 2005.
Carbon Monoxide	$\mu g/m^3$	8 hours[b]	10,000	To be determined before 2005.
		15 minute	100,000	Indicative samplers [c]
Lead	$\mu g/m^3$	Annual	0.5	Atomic Absorption Spectrometry, analysis of PM10 samples [d]
		24-hours		
Benzene	$\mu g/m^3$	Annual	20[e]	Diffusive sampling based on weekly averages
		24-hours		

$\mu g/m^3$ = microgram per cubic meter, PM 10 = particulate matter of diameter 10 micron or less
[a] 24 hourly values shall be met 95% of the time in a year. The standard may be exceeded on 18 days per calendar year, but not on two consecutive days.
[b] 24 hourly standards for NO_2 and SO_2 and 8 hours standard for CO are not to be controlled before MoPE has recommended appropriate test methodologies. This will be done before 2005.
[c] Control by spot sampling at roadside locations: minimum one sample per week taken over 15 minutes during peak traffic hours, i.e., in the period 8 am –10 am or 3 pm–6 pm on a workday. This test method will be re-evaluated by 2005.
[d] If representativeness can be proven, yearly averages can be calculated from PM10 samples from selected weekdays from each month of the year.
[e] To be reevaluated by 2005.
Source: MOPE (2003)

Table 7.4: Vehicle Emission Standards for Green Stickers

Type of Vehicle	CO% by Volume	HC (ppm)
Petrol-Operated Vehicles		
Four-wheelers 1980 or older	4.5	1,000
Four-wheelers 1981 onwards	3.0	1,000
Two-wheelers (two-stroke)	4.5	7,800
Two-wheelers (four-stroke)	4.5	7,800
Three-wheelers	4.5	7,800
Gas-Operated Vehicles		
Four-wheelers	3.0	1,000
Three-wheelers	3.0	7,800
Diesel-Operated Vehicles		
Older than 1994	75.0	
1995 onwards	65.0	

ppm = parts per million, CO = carbon monooxide, HC = hydro carbon
Source: MOPE (2003)

The introduction of improved cooking stoves commenced in 1950 to reduce indoor air pollution. The national ICS Programme has disseminated about 125,000 ICS in 33 mid-hill districts. Similarly, the Biogas Sector Program has built 137,000 family-size biogas plants in 66 of Nepal's 75 districts, saving 400,000 tons of firewood and 800,000 liters of kerosene, and preventing 600,000 tons of greenhouse gases from escaping into the atmosphere (Nepali Times 2005). Likewise, estimates in 1998 indicate that almost 1,000 micro-hydropower plants are in operation (SHTF undated) and 1,100 kW of photovoltaic power is used in various public and private sectors of Nepal (EnvironmentNEPAL 2003).

New methods for prevention and early warning of glacial lake outburst floods are also being developed and installed, although so far only at one lake, the Tsho Rolpa (Mool et al. 2001). Prevention involves recognition of the potential problem and employment of modern engineering measures like controlled draining. Modern early warning systems provide alarms downstream that enable timely evacuation of people and animals and protective measures to be taken for property.

Another longer term possibility for more far reaching change—use of hydrogen as an energy source—is described in the box.

Conclusion

The energy, industry, and transportation sectors are the major contributors to air pollution. The use of low quality fuel, inefficient methods of energy production

Hydrogen Energy—A Brighter Option for Nepal

Energy is a vital input to the national economy and wellbeing of people. Normally, economic growth requires more use of energy. Current patterns of energy use result in emissions of pollutants. Local-level pollutants such as carbon monoxide, suspended particles, and hydrocarbons degrade air quality and damage health. Sulfur dioxides and nitrogen oxides are examples of regional level pollutants that contribute to acid deposition, which can damage vegetation such as forests and crops, and human-made structures. Large increases in emissions may occur during the next 20 to 50 years if current trends persist. Air pollution has become a priority issue in most countries in Asia.

At present sustainable energy is of increasing interest in the region. The rapid growth of atmospheric environmental issues along with the fear of energy shortages is creating a consensus about the potential benefits of hydrogen from renewable energy sources. These interesting perspectives are further supported by the development of key technologies, such as renewable energy sources, advanced production processes, and fuel cell vehicles. This provides an ideal opportunity to introduce a hydrogen economy in Nepal. Nepal is one of the top five countries in the world in terms of hydroelectric production potential. Nepal could provide the opportunity to introduce emission-free production of hydrogen energy not only to the country but for the whole region. In addition, Nepal has the added advantage of cheap labor which can support the production of hydrogen at an affordable price. The economic and environmental benefits of hydrogen energy could also help to reduce poverty by creating domestic jobs and providing electricity beyond the national power grid.

Source: A project proposal by UNEP RRC.AP.

and use, and poor condition of vehicles and traffic management are among the reasons for increasing emissions in Nepal. Biomass burning for cooking and space heating is a source of indoor air pollution and resultant health effects. Though long-term data on pollution are lacking, available information reveals that the nature and extent of air pollution is serious in major urban areas and in the hill regions of Nepal.

Air pollutants also contribute to the developing problem of climate change, although it is not possible to assess to what extent. At the same time, climate change will itself have an impact on the pattern and extent of air pollution.

As Nepal imports petrol, it should start demanding low benzene petrol. It should also emphasize zero-emission electric vehicles such as trolley busses and Safa tempo. In the long term, Nepal should opt for hydrogen energy which will benefit the country both economically and environmentally. Though the capital investment cost is higher at the beginning, this would be repaid in the long run.

Raising awareness is another fundamental measure to curb air pollution. This can be done through hands-on workshops, seminars, and site visits. However, the media should play a key role in the overall strategy. Media coverage of key messages that need to be delivered to primary stakeholders would reinforce the importance of those messages. At the same time, using the media ensures that these messages reach the general public as well, serving as information as well as reinforcing the importance of those messages.

Along with awareness raising, capacity building is equally important. Scientific information remains the basis for any pollution-control efforts, and capacity building of both institutions and individuals is vital. The contemporary view of capacity building goes beyond the conventional perception of training. The central concerns of air quality management to manage change, to resolve conflict, to manage institutional pluralism, to enhance coordination, to foster communication, to develop a strong credible database, and to ensure that data and information are shared—require a broad and holistic view of capacity development, which is still poor in Nepal and needs to be strengthened.

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Appendix 7.1: World Health Organization Guideline Values

Compound[a]	Guideline Value	Averaging Time
Ozone	120 micrograms/cubic meter (0.06 ppm)	8 hours
Nitrogen dioxide	200 micrograms/cubic meter (0.11 ppm)	1 hour
	40 to 50 micrograms/cubic meter (0.021 –0.026 ppm)	1 year
Sulfur dioxide	500 micrograms/cubic meter (0.175 ppm)	10 min
	125 micrograms/cubic meter (0.044 ppm)	24 hours
	50 micrograms per cubic meter (0.017 ppm)	1 year
Carbon monoxide [b]	100 mg/cubic meter (90 ppm)	15 min
	60 mg/cubic meter (50 ppm)	30 min
	30 mg/cubic meter (25 ppm)	1 hour
	10 mg/cubic meter (10 ppm)	8 hours
Lead [c]	0.5 to 1.0 micrograms/cubic meter	1 year

mg = milligram, p pm = parts per million

[a] Guideline value for particulate matter is no longer set because there is no evident threshold (lowest safe level) for effec ts on morbidity and mortality. (See below for previous guideline value for particulate matter).

[b] The guideline is to prevent carboxyhemoglobin levels in the blood from exceeding 2.5%. The values are mathematical estimates of some CO concentrations and averaging times over which this goal should be achieved.

[c] The guideline for lead was established by WHO in 1987.

Source: WHO Ambient Air Quality Guidelines, http://w3.whosea.org/techinfo/air.htm

Previous WHO Guideline Value for Particulate Matter

WHO Air Quality Guidelines (mg/m^3)

Duration	TSP	PM10
Long Term (annual average)	60–90	
Short Term (24 hour average)	150–230	70
Short Term (8 hour average)	120	70

Source: CBS (2004)

Chapter 8

Urban Environment

Introduction

Urban areas play an important role in economic, political, and cultural development. The concentrated population and production in urban areas leads to greatly reduced unit costs in providing and managing basic infrastructure and services, better employment and livelihood opportunities, and easier participation in the political process. The same concentration, however, makes urban areas consumers of resources and producers of pollution, resulting in a wide range of environmental problems in the cities and beyond.

Historically, cities grew gradually over long periods of time, which provided time and opportunity to address their emerging needs. In the past half-century, the pace of urbanization in developing countries has accelerated greatly. Often, rapid urban growth has taken place without matching expansion of the infrastructure, services, and facilities necessary for an adequate and healthy urban environment, and without adequate planning or regulation. This has caused deterioration in urban environmental quality. Urban areas commonly face shortages of safe drinking water and inadequate provision of sanitation, solid waste collection and disposal, drains, paved roads; and other forms of infrastructure and services necessary for a healthy environment. This results in bad water and air quality, unmanaged or mismanaged waste, and increasing noise pollution. Urban areas also face problems in controlling encroachment into public spaces and degradation of cultural sites and heritage. Rapid urban growth in itself need not produce serious environmental problems provided environmental implications are considered in a systematic, timely, and adequate way.

Kathmandu Valley is the most urbanized region in Nepal and its urban areas have been important economically, administratively, and politically for hundreds of years. The urbanization of Kathmandu Valley goes back over 1500 years, and the old towns of the Valley are characterized by a strong cultural history and pattern—dense settlement with courtyards as in-town open space, squares as intervening open spaces, temples and other cultural sites, and greenery and open space at the periphery. The old settlements were located at relatively higher elevations and surrounded and separated from each other by agricultural land; almost all waste was biodegradable, and sewage was used in agriculture. Until fairly recently, except for sanitation, the environmental quality of the Valley towns was excellent (HMG/UNDP 1994). In the process of rapid growth, Nepal's urban areas now face all the above-mentioned problems of infrastructure and service deficiency, and environmental management.

Urban Growth and Features

Urban Settlements

The municipalities designated by the Ministry of Local Development are the areas in Nepal formally defined as urban. The criteria for designating municipality status have been revised several times since 1952 (Table 8.1). The current definition is given by the Local Self Governance Act 1999, which classifies municipalities into three hierarchical levels: metropolitan city, sub-metropolitan city, and municipality. At present there are 1 metropolitan city (Kathmandu), 3 sub-metropolitan cities (Biratnagar, Lalitpur, Pokhara, and Birganj), and 53 municipalities.

The density, contiguity, and occupational structure of the population—which are generally accepted criteria for defining urban areas—have never been considered in designating municipalities

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Table 8.1: Criteria for Urban Status

Act or Guidelines	Criteria
The 1952/54[a] census	Identified 10 "prominent" settlements with populations exceeding 5,000 (but not formally categorized as urban areas).
The 1961 census	An area with a population cluster exceeding 5,000 and having an urban environment such as high school, college, judicial and administrative offices, bazaar, communication facilities, mills, and factories.
The Municipality Act of 1962	An area with a population exceeding 10,000 with an urban environment
Local Self-Governance Act 1999	Metropolitan city: a municipality with a "minimum population size of 300,000; annual revenue of at least NRs400 million ; facilities of electricity, drinking water, communication, paved main and subsidiary roads; provision of specialized health services; essential infrastructure for international sports events; adequate opportunities for higher education in different fields; at least one established university; adequate urban facilities, and an area that has already received the status of Sub-Metropolitan". Sub-Metropolitan city: a municipality with a "minimum population size of 100,000 ; annual revenue of at least NRs 100 million; facilities of electricity, drinking water, communication, paved main roads, education and health services of high standard; general infrastructure for national and international sports events, provision of public parks , a city hall , and similar urban facilities; and that has already received the status of a Municipality". Municipality (Terai): minimum population size of 20,000; annual revenue of NRs5 million ; and minimum urban facilities such as electricity, roads, drinking water, and communications Municipality (Hill/Mountain): minimum population size of 10,000; annual revenue of NRs500,000, and minimum urban facilities such as electricity, roads, drinking water, and communications

[a] Census of 1952/54 covered two Nepali years, approximately mid April 1952 to mid April 1954.
Source: Ministry of Law and Justice (1999); Sharma (2003)

in Nepal. Population size, revenue generation, and availability of facilities and services appear to be the basis for designating a settlement as an urban or municipal area. These criteria, however, have not been strictly and consistently applied over the decades in assigning municipality status to a locality. Some areas have been classified, de-classified, and re-classified as municipalities over the past 50 years, and the territorial boundaries of many settlements have been re-drawn to include surrounding rural areas to meet the population size criteria. This might have been motivated by political interests. As a result, significant parts of the territories of several formally defined municipalities may not exhibit an urban character, while other settlements like small or emerging towns not yet formally defined as municipalities may show a more urban character.

Population Trends

Nepal is one of the least urbanized countries in the world. In 2001, the last year for which reliable statistics are available, 14% of the population lived in urban areas. However, the rate of urban growth has been fast in recent decades: the rate of urbanization increased markedly from the 1970s onward and is among the highest in Asia and the Pacific. Between 1952 and 2001, the number of formally designated urban centers grew from 10 to 58, with a corresponding increase in urban population from 0.2 million to 3.2 million; a sixteen-fold increase. The urban population was only 3% in 1952 (Table 8.2). The ratio of urban population to total population has increased progressively, and the annual average growth rate of urban population exceeded the national population growth rates throughout the period from 1952 to 2001. One projection suggests that Nepal's urban population will be more than 6 million by 2011, the 58 municipalities will contain over 20% of the national population, and 16 towns will exceed 100,000 population (Joshi 1999). In general, urban growth is expected to continue rapidly. According to the ADB (2000), the major reasons for rapid growth in Nepal's urban population include the following:

(i) High levels of rural to urban migration: the general trend of migration in Nepal is from Hill/Mountain regions to the Terai (plain) and from rural to urban. The insurgency that began in 1996 has significantly accelerated rural-urban migration;
(ii) A high population growth rate;
(iii) Extension of existing municipal boundaries; and
(iv) Designation of new municipalities.

With increasing urbanization, the urban economy is growing at a rate of 6.4% per annum, more than double that of the rural economy, and the contribution to the national economy is estimated to be around 60% of gross domestic product (GDP) (Nippon Jogesuido Sekkei 2002).

Table 8.2: Summary of Urban Growth Trends in Nepal 1952/54 [a]–2001

Item	1952/54[a]	1961	1971	1981	1991	2001
Urban population ('000)	238.3	336.2	461.9	956.7	1,695.7	3,227.9
Number of urban places	10	16	16	23	33	58
Percentage of Urban Population (and Places) by Region						
Hill/Mountains	0	4.8 (3)	7.4 (3)	8.7 (4)	11.4 (8)	17.8 (20)
Kathmandu Valley	82.6 (5)	64.9 (5)	54.0 (3)	38.0 (3)	35.3 (3)	30.9 (5)
Inner Terai	0	0	3.5 (1)	10.1 (4)	9.5 (4)	12.1 (8)
Terai	17.4 (5)	30.3 (8)	35.0 (9)	43.2 (12)	43.9 (18)	39.2 (25)
Level of Urbanization by Region (Urban Population as % of Total Population)						
Hill/Mountains		—	—	1.2	2.5	6.4
Kathmandu Valley	—	—	—	47.4	54.1	60.5
Inner Terai		—	—	7.6	9.5	18.0
Terai	—	—	—	6.8	9.4	12.3
Nepal	**2.9**	**3.6**	**4.0**	**6.4**	**9.2**	**13.9**
Average Annual Growth Rates of Urban Population During Intercensus Periods (10 years)						
Hill/Mountains	—	—	7.78	9.27	8.73	11.58
Kathmandu Valley	—	—	1.36	3.86	5.11	5.22
Inner Terai	—	—	—	19.59	5.18	9.34
Terai	—	—	4.74	9.82	6.06	5.44
Nepal's Urban Area (overall)	**—**	**—**	**3.23**	**7.55**	**5.89**	**6.65**
Urban Density (person s per km^2)						
Hill/Mountains	—	—	—	—	—	550
Kathmandu Valley	—	—	—	—	—	10,265
Inner Terai	—	—	—	—	—	402
Terai	—	—	—	—	—	1,092
Urban Total	**—**	**—**	**—**	**—**	**—**	**985**
Rural Total	**—**	**—**	**—**	**—**	**—**	**136**

— = not available , km^2 = square kilometer
[a] Census of 1952/54 cover ed two Nepali years, approximately mid April 1952 to mid April 1954
Source: Sharma (2003) pp. 375–412.

Pattern of Urbanization

Urbanization has not occurred evenly throughout the country (Table 8.2). Kathmandu, the capital city, is the main urban center and dominates in terms of concentration of population and economic activities; it has been growing at a very high annual rate in excess of 7% (Nippon Jogesuido January 2002). The Hill/Mountain region remains the least urbanized in the country, and Kathmandu Valley consistently remains the most urbanized region, although its share of urban population has been declining and has been exceeded by the Terai region since 1981. In general, regions with low levels of urbanization have been experiencing faster urban growth and regions experiencing slower rates of urban growth are the ones where the existing level of urbanization is higher.

Over 39% of Nepal's urban population in 2001 resided in metropolitan and sub-metropolitan areas with populations over 100,000. Nepal currently has 45 urban areas with populations between 20,000 and 100,000, against only 6 in 1971. These contain over 54% of the urban population. Several of these are district headquarters, which have been important trade centers with long histories. In 2001, only about 4% of the urban population lived in the eight urban centers with populations between 10,000 and 20,000.

There are many small market towns with populations under 10,000. Although there is no adequate information available on their population and growth rates, it is clear that these are growing quite fast. They now frequently contain significant populations and appear more urban than the outskirts of many designated municipalities. These small market towns are not yet classified as urban areas. New roads, improved accessibility, and infrastructure development led to their emergence as towns, and several of the newly emerged small towns are on highways and feeder roads. Many of these had been only small rural trading centers, villages, or did not exist until a few decades ago. They generally lack basic infrastructure to

accommodate the rapidly increasing population pressure (newspaper articles, personal communication and observation, and Joshi 2000).

Only Kathmandu has reached a population of 500,000 inhabitants or more, and at present only five urban areas—Biratnagar, Birganj, Kathmandu, Lalitpur, and Pokhara—have populations exceeding 100,000. Except for Kathmandu, all have populations less than 175,000. Nepal's population size and urban-based economy are small and would not be conducive to larger cities. Migration is likely to be greatest to those urban areas where land for housing is comparatively cheap, where there are employment and livelihood opportunities, and where there are reasonable urban facilities such as education, health, and communications. This logic, and the past trend, suggests that urban areas with current populations in the range of 50,000 to 100,000 are likely to be the preferred destinations for migration. The trend in the last three decades also supports this argument: between 1971 and 2001, population in urban areas of 50,000 to 99,000 grew from 13% to 24% of the total urban population, whereas the percentage declined among all other sizes. The typical population of Nepalese towns in the next decade or so is likely to be 100,000 to 200,000. Most of Nepal's urban centers are unlikely to have populations exceeding 300,000 in the next 10 to 15 years.

Most urban areas are not very densely populated in terms of persons per unit area (Table 8.2). The urban areas of Kathmandu Valley are the most densely populated in Nepal. Urban densities in some of the municipalities, particularly in the Hill/Mountain region, are only slightly higher than that of rural areas. For example, the density of Triyuga and Amargadi municipalities is 172.8 and 132.5 persons per square kilometer, respectively, which is comparable with the rural density (Sharma 2003). Population densities may be higher in smaller or emerging towns that are not yet classified as urban areas. Several municipalities exhibit a more rural than urban character because of expansion of boundaries of the existing towns in the process of gaining municipal status to include population on the fringes that was hitherto classified as rural. Some municipalities are not even linked with the rest of the country by road, and the outskirts of many municipalities can be reached only by a walk of 3–4 hours.

Emerging Problems

Most urban areas of Nepal have cultural and heritage sites of varied nature including historical settlements, monuments, religious sites (temples, monasteries, and others) and ponds and public taps. These are of local, national, and international significance; some are listed as World Heritage Sites by the United Nations Educational, Scientific and Cultural Organization (UNESCO) (including the Pashupatinath temple, Boudhanath, Swayambhunath, palace areas of Hanuman Dhoka, Patan, and Bhaktapur, Changu Narayan temple, and Lumbini). However, according to IUCN (1999) "the physical state of the cultural and heritage sites and the monuments in Kathmandu Valley is fast deteriorating". The cultural and heritage sites along rivers are the worst affected.

Emergence of urban slums and squatter settlements in Nepal's cities is relatively new and still small in size compared with other cities in South Asia. There are no adequate data on slum dwellers in Nepal nor is there a definition of "slums". However, the number of squatter settlements in major urban areas has been increasing in the last few years; it is most conspicuous in Kathmandu Valley. In 1985 the number of squatter settlements in the Valley was 17 with an estimated 3,000 inhabitants; this grew to 33 with an estimated population of 15,000 in 1990 (Pradhan 2004); and to 44 in 2002 (Baniya 2002). Pathibhara is the largest recorded squatter settlement with 187 households and 2000 family members. All these squatter localities and some of the core areas of Kathmandu are said to be slums due to lack of basic sanitation and utility facilities. The emergence and expansion of the squatter settlements has been encroaching upon riverbanks, public lands, lands belonging to temples or other religious/cultural sites, agricultural land, and forest areas.

Urban Infrastructure

Roads and Traffic

In 2000, the total road length in the urban areas of Nepal was 2,051 km, of which blacktopped, graveled, and earthen road lengths were 930 km, 600 km, and 521 km, respectively (CBS 2002). There is considerable variation in the length and status of urban roads in municipalities depending on their size and location. For example, Waling has only 8 km of road within its territory whereas Kathmandu has 800 km (SWMRMC 2004). Some municipalities are completely devoid of blacktopped roads, and some are not even linked with the national road network.

Urban traffic in Nepal is typically a mix of traffic types including automobiles, cycle rickshaws (manual three-wheeler), bicycles, and even animal-drawn carts. The numbers and composition of traffic vary from municipality to municipality. Rickshaws and bicycles are most conspicuous in the Terai towns, whereas cars and motorcycles make up over

half of all motor vehicles in Kathmandu. Most of the growth in motor vehicle fleets is concentrated in Kathmandu Valley. In March 2004, for example, the number of registered automobiles in Nepal was 418,910, of which about half were in Kathmandu Valley (DOTM 2005).

Water Supply

In 2000, about 78% of the people living in urban areas had access to an improved water supply within 15 minutes of home (WaterAid Nepal 2004). However, there is significant variation in the coverage, service level, and qualities of supplied water between and within urban areas. A survey conducted in 2002 in nine municipalities outside Kathmandu showed that piped water supply coverage varied from 7% to 65% of households (Nippon Jogesuido 2002). Groundwater is the main source of water in the Terai and is generally adequate in terms of quantity; hill towns are served from surface sources and generally face serious water availability problems. Quality of supplied water is quite often a concern; arsenic content has become an alarming issue in many rural water supply schemes in the Terai, whereas biological contamination is generally the main concern where surface water is used. Except for a few towns such as Dhulikhel, Damak, and Mechinagar, water supplies are intermittent, with water available only a few hours a day (ADB 2000). Inadequate quantity, non-uniform distribution of water, unreliability of supply, and high rate of unaccounted for water (due to leakage and illegal connections) are major issues related to water supply in the urban areas of Nepal. The rate of unaccounted for water is particularly high in Kathmandu (IUCN 1999; ADB 2000).

Sanitation and Drainage

In 2000 sanitation coverage in urban areas of Nepal was 67% of the population (WaterAid Nepal 2004). The provision of sanitation infrastructure is generally very poor: a significant proportion of the urban population outside Kathmandu is still not connected to wastewater or sewerage systems. In smaller towns, households are either without sanitation facilities or served by septic tanks or pits, or illegally use storm water drains as sanitary sewers. Wastewater treatment facilities are very limited, and where provided they suffer from chronic disrepair, maintenance, and operation problems, and are often non-functional. For example, three sewage treatment plants in Bhaktapur and Lalitpur are not functioning.

Sewerage systems, often combined with storm water drainage systems, only exist in some urban areas; and their coverage is limited. The combined sewerage systems in Kathmandu, Lalitpur, and Bhaktapur cover approximately 13,000 households (ADB 2000). A 2002 survey in nine small towns outside Kathmandu revealed that, in general, only parts of town centers have storm drainage; some are covered but most are uncovered (Nippon Jogesuido 2002). In these towns, the total length of storm drains varied from 2 to 22 km. During the rainy season, drainage is a serious problem, particularly in the urban areas of the Terai.

Solid Waste

Solid waste is generally very poorly managed by municipalities in Nepal (ADB 2000). More than half of the municipalities have not even identified or proposed sites for land-filling their wastes, let alone carrying out proper land-filling. In general, waste is collected, transported, and disposed of by municipalities. Lack of resources—including human resources, infrastructure, and equipment—is a common problem faced by municipalities in attempting to manage solid waste. Siting and operation of landfills is highly sensitive and controversial. Many municipalities have worked in partnership with the private sector, nongovernment organizations (NGOs), and community groups in

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Abandoned Chamber Built for Burning Medical Waste

managing solid waste. They are particularly involved in awareness, waste collection, and street cleaning. Some NGOs have piloted door-to-door collection, composting, and recycling (NEFEJ 2004). One emerging concern is the management of hazardous wastes. There is no clear state policy on this. Medical waste, obsolete pesticides, batteries, effluent, and byproducts of industries are the main sources of hazardous waste. Few health institutions have autoclaves and incinerators: and where they exist they are quite often not in operation.

Urban Environmental Concerns

Solid Waste

Quantity and Nature

The municipalities of Nepal generate over 1,350 tons of solid waste every day. Kathmandu alone generates 383 tons/day, slightly less than one-third of the total municipal waste. Household waste constitutes about 75% of municipal waste. The municipal waste varies from 0.11 to 0.93 kg per person per day, with an average of 0.34 kg per person per day (SWMRMC 2004). The households on the outskirts of the smaller towns (which, although falling within the municipality boundary, are rural in nature) reuse most of their waste for feeding animals (pigs and cattle).

With the change in consumption patterns and lifestyle of urban inhabitants, the composition of solid waste has been changing over the years, from traditional organic materials to papers, plastics, glass, metals, and packaging materials. Even so, about two-thirds of municipal waste is still organic or biodegradable although the composition varies from municipality to municipality. A recent study (SWMRMC 2004) showed the following average composition of the solid waste generated in Nepalese municipalities:

(i) Organic material 66% by wet weight (with a range of about 39 to 95% from municipality to municipality);
(ii) Metal, glass, paper, and plastic combined, 20% by wet weight (range 5 to 50%); plastic alone constitutes 7.6% (range 1.6% to 21%);
(iii) Inert material 9.6% (range 0 to 37%); and
(iv) "Other" (including medical waste) about 5%.

Management Practices and Concerns

Solid waste is the most conspicuous environmental problem across Nepal's urban areas. According to ADB (2000), until the 1980s, municipal solid waste management problems were negligible other than in Kathmandu Valley—most of the waste generated being organic and thus managed at the household level.

Sweepers clean the streets and open spaces, collecting the waste into roadside heaps using brooms, picks, shovels, and wheelbarrows; waste is also picked up from roadside heaps or bins and transported to disposal points by tractors and trailers, power-tillers, rickshaws, or other waste transportation vehicles. However, the solid waste collection rate is generally low. On average only 35% of municipal waste is collected; but rates vary from about 7% to as high as 86% from one municipality to another (SWMRMC 2004). Disposal of waste is haphazard. Even the capital city dumped waste along the riverbanks until very recently. Almost all municipalities currently lack any landfill site; Pokhara municipality started disposing of solid waste at a landfill site after a long negotiation with the people residing in the neighborhood, and the Solid Waste Management and Resource Mobilisation Center recently reached agreement with the local people to dispose of the capital city's waste at Sisdole for two years, by which time a long-term site is expected to be ready at Okharpauwa.

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Sisdole Landfill Site for Kathmandu Refuse

Random and insanitary collection and disposal of urban solid waste in Nepal is the result of lack of long-term perspective; deficiency in the planning, provision and operation of infrastructure; insufficient public lands that can be accessed for waste disposal purposes; and absence of a holistic and integrated system for solid waste management. Solid waste management is generally understood as sweeping the street and dumping waste in places where it receives no public opposition. Hence, waste is commonly dumped on public land, forest, riverbanks, and other places ill-suited for this purpose. Irregularity of collection is common, with heaps of garbage found piled up on the streets.

Sanitary Landfill Site and Land-filling

Land-filling is a commonly used method for solid waste disposal. A landfill site is first selected considering present use and value of land; available area and potential life of landfill; the site's soil and topography, geology, and hydrology; haulage distance; and settlements near the site. The selected site is developed into a proper landfill site by providing drainage, access, and other structures and facilities necessary for a landfill operation. Operation involves laying the waste in layers, compacting it, and covering it with earth at the end of each day's operation. Many landfill sites around the world have been poorly engineered and operated, and hence face vociferous public opposition and criticism for their adverse environmental impacts. The decomposition of the organic matter in a landfill site produces highly polluting liquid, called leachate, and gases (mainly methane and carbon dioxide). Leachate can percolate down, causing groundwater pollution. Methane is a combustible gas and explosive when its concentration in air is between 5% and 15%. Methane can accumulate below buildings or other enclosed spaces on or close to a landfill, posing risk of explosion. Other common concerns related to land-filling are odor; litter blown by the wind; scavenger birds, rodents and insects attracted by the organic refuse; and dust and noise generated by the heavy trucks and equipment used in transporting waste and operating the landfill.

Because of the concerns arising from poor operation and management, siting and operation of landfill sites is a very sensitive public issue in Nepal. For a decade or so Kathmandu city has been facing a severe problem in disposing of its solid waste. In the early 1990s, people near the then-existing landfill site at Gokarna opposed the landfill and obstructed its operation many times, resulting in waste accumulation on the streets of Kathmandu for several days, or inappropriate disposal of waste along the riverbanks. Later when the life of the Gokarna landfill site was finished, no other landfill site could be identified within the Valley due to public opposition, and Kathmandu's refuse continued to be disposed of along the riverbanks. In 2005, authorities reached an agreement with local people to operate a short-term (2-year) landfill at Sisdol with a plan to prepare a long-term landfill site at Okharpauwa in the same locality.

Shortcomings in planning and design as well as poor operation and management are the primary causes of public opposition to landfill sites. State-of-the art practice requires improvements in the way landfill sites are planned, designed, operated, and managed. A landfill site needs to have a buffer zone separating it from settlements and public places, a liner should be placed at the bottom of the landfill site to control flow of the leachate to the groundwater, leachate should be collected and treated, and gases (particularly methane) need to be collected and either safely vented or used as fuel, in addition to compaction and daily covering of the waste put in layers. Besides, waste may be segregated into decomposable, reusable, recyclable, and the rest. Not all waste needs to be land-filled: decomposable waste can be converted into compost, and reusable and recyclable waste could be sold. The decomposable fraction of waste typically exceeds 60% in Nepal and is the one that produces leachate, gases, and attracts birds and insects. Separating this from the remaining waste not only reduces the volume to be land-filled (thus increasing the life of the landfill), but also reduces the chances of adverse environmental problems and public opposition.

Lalitpur Municipality

Open Dumping of Medical Waste

Such a state has many adverse environmental consequences. In the first place, it is aesthetically bad, causes bad smells, and is a nuisance to the public. Refuse also attracts animal scavengers and pests, can be a breeding place for disease-vectors, and can be hazardous to human health. Uncollected refuse gets into drains and blocks them, causing disruption to drainage and sewerage systems. Irregular collection encourages people to burn waste which contains plastics and chemicals—the resulting emissions have long-term health implications. The refuse also produces leachate that can contaminate surface water and groundwater if not handled properly. Haphazard solid waste collection is also a source of air pollution. Overall, unmanaged solid waste not only causes significant adverse impacts on public health and the environment but also deterioration in the quality of life of people.

In most municipalities, hazardous wastes are commonly mixed and dumped along with municipal waste. Most commonly, industrial waste is either burned, dumped, drained in a river, or mixed with municipal waste. Similarly, hospital waste is either burned in a chamber within the hospital compound or mixed with municipal waste (SWMRMC 2004). Mixing such wastes with municipal waste renders the latter hazardous and potentially infectious.

Solid waste in Nepalese urban areas could be better managed by adopting a more holistic and integrated approach that internalizes the concept of the 3Rs (reduce, reuse, and recycle). Some elements of this have been tried on a limited scale in Nepal, although these remain unguided, uncoordinated, or isolated and out of the mainstream solid waste management practice. For example, there are several small-scale recycling industries using waste plastics as raw materials, and paper is recycled in a paper mill and also by some NGOs (NPC and UNDP undated). Scavengers collect beverage bottles, which are mostly reused, and metal scraps, which are recycled in factories in India and Nepal. Bhaktapur municipality has been composting its solid waste for some time now; a compost plant of about 13 tons/day was operational until a few years back in Kathmandu, and several NGOs and community groups in different urban areas have initiated door-to-door waste collection and small-scale composting, including vermi-composting as well as briquette production (NEFEJ 2004). All these indicate that waste can be converted into a resource, provided the right policy and approach are followed.

Solid Waste Management by an NGO

The Women Environment Preservation Committee (WEPCO) is a nonprofit NGO formed in 1992 by a group of enthusiastic women from Kupondole, Lalitpur. From its beginning, WEPCO has been actively and continuously involved in solid waste management in the Kupondole area of Lalitpur Municipality. The solid waste management it practices and promotes is more than just collection and disposal of waste; it incorporates the concept of recycling and converting waste into resources. WEPCO provides door-to-door waste collection service to about 80% of the area households, for which each household pays a monthly charge. The biodegradable fraction of the waste is converted into organic compost. WEPCO also recycles paper collected from different sources. WEPCO has shown an example on a small scale of how "waste" may be better managed by also considering it as a "resource". WEPCO is also active in training and disseminating the experiences and lessons learned to other NGOs and community groups, raising community awareness on the 3Rs, and promoting composting at household level. WEPCO is working in partnership with Lalitpur Municipality and the private sector. In recognition of the work done, WEPCO was awarded the MOPE Environment Award 1996, UNEP Global 500 Environment Award 2003, and World Wild Fund for Nature (WWF) Nepal Program Abraham Conservation Award 2003.

(Source: personal communication with WEPCO).

Water Pollution

Water pollution is a serious environmental issue in Nepalese urban areas. Pollution of water bodies such as rivers, lakes, ponds, groundwater, and drinking water supplies are common.

Deficiency in wastewater and solid waste facilities and their mismanagement have often resulted in pollution of surface and groundwater. Using storm water drains as sanitary sewers is a widespread practice in Nepal. Sewerage systems, often combined with storm water drainage systems, exist in a number of urban areas such as in greater Kathmandu and Bhaktapur, although their coverage is inadequate and they are in a poor state of maintenance. Greater Kathmandu and Bhaktapur are the only urban areas with sewage treatment plants; however, these plants are not functioning and the untreated sewage is discharged directly into rivers. Major polluting industries, such as tanneries, sugar, paper, canning, cement, breweries, and pharmaceutical industries, are invariably located in or near urban areas and often dispose their waste,

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Stream Changed into a Sewer in Kathmandu

Bagmati River Pollution

The Bagmati River with its tributaries—the Bishnumati, Manohara, Dhobikhola, Icchumati (Tukucha), Nakkhu, Hanumante, Karmanasa, and Godavari—is the main river in Kathmandu Valley. The Bagmati River system is extremely important for both the Valley and downstream areas. The river system has been the Valley's main source of water for drinking and irrigation, and an important component of its ecosystem. It also has tremendous religious, cultural, and social significance—the river is worshipped by millions of Hindus in Nepal and India. Several temples (including Pashupatinath), ghats, and maths are located along the banks of the Bagmati River and its tributaries. People perform various religious and cultural activities and rituals, and take holy ablution there. It is often referred to as the Ganges of Nepal.

Over the last few decades, the Bagmati's condition has gradually deteriorated and it has become the most polluted river in Nepal. Direct disposal of untreated sewage and throwing garbage into the river system, withdrawal of sand, tapping river water to meet the water demand of the increasing population as well as of the increasing number of factories, and encroachment of the river banks are the main causes of the degradation and extreme pollution. During the dry season, the volume of water is so reduced and the river is so polluted that it looks like an open sewer. One study conducted by the Environment and Public Health Organization (Dhakal 2003) showed that the chemical oxygen demand (COD) is in excess of 400 mg/l within the city and immediate downstream areas. This is alarming, as the normal COD of river water is around 40 mg/l. However, as the river flows out from the Valley, the pressure on it reduces considerably and due to natural self-purification processes, the COD is reduced to 25 mg/l by the time it reaches Gaur in Rautahat.

The effects of this extreme pollution are many. The most visible is aesthetic: a highly polluted, sewage-filled, black stream flowing through the heart of the city obviously destroys the city's beauty. Pollution has also affected cultural and religious activities and rituals—ritual bathing is almost a thing of the past, and people do not use river water even when performing puja. The health of the people living along the banks is also at risk. Villagers immediately downstream of Kathmandu have now stopped using the river water for irrigation, and fishermen have stopped their traditional occupation, as there are no fish left in the river. The river is almost dead, and aquatic life is almost nonexistent when the river reaches Chobhar area (Dhakal 2003; Phuyal 2003).

including toxic waste, to roadside drains and open spaces. The only industrial wastewater treatment plant, at Hetauda, often encounters operational difficulties (ADB 2000; IUCN 1992). Thus, the rivers have become major places for disposal of untreated sewage and industrial effluents, as well as urban solid waste dumping. This is the principal cause of surface water pollution. As a result, many rivers in urban areas have practically become open sewers, especially during the dry season. The adverse effects of this are many, such as eutrophication affecting river ecology and aquatic life, and making the water unfit for most human uses including bathing and irrigation. The effects are not confined to urban areas, but can be felt for long distances downstream.

Groundwater in most urban areas is contaminated due to seepage from pits and septic tanks, and open defecation. Studies of water quality from shallow aquifers throughout Nepal have found that the fecal coliform contamination consistently exceeds World Health Organization (WHO) guidelines for water for human consumption (ADB 2000).

Drinking water supplies are often polluted through runoff into storage sites or cross-leakages between overloaded sewer lines and water pipes (IUCN 1991). Sewage is the primary cause of drinking water pollution. Nearly one-third of the urban population of Nepal do not have direct access to a piped water supply. The availability of improved

B. Pradhan

Waste Dumping along the Bagmati River in Kathmandu

water supply, including non-piped, within 15 minutes of walking distance is nearly 80% (WaterAid Nepal 2004; CBS 2004). Even those with access do not necessarily have adequate water. The quantity of water delivered by the water supply system is mostly below 50 liters per capita per day and the quality often falls below WHO recommendations (ADB 2000), mainly due to bacteriological contamination caused by poor sanitation facilities. Unserved households obtain water from traditional water sources such as wells, rivers, springs, or ponds. These sources are typically unprotected, and water quality is usually poor. Water pollution is the most serious public health issue in Nepal. Contaminated drinking water and lack of sanitation facilities result

in worsening public health conditions, deteriorating quality of life, and increased economic costs to society. While this affects people of all income levels, the poor are most vulnerable. They have few resources or alternatives to protect themselves from such adverse impacts as seasonal drying out of surface water sources, pollution of groundwater, or spread of sanitation-related diseases.

Drainage

Drainage to cope with surface runoff is often deficient in Nepalese urban areas. This is most evident during the rainy season; the limited lengths of drains that exist in urban areas are often filled with waste, including plastics and dirt. As a result, the surface runoff either infiltrates the ground or flows into natural drains through streets and lanes, leaving the towns muddy and dirty. Urban areas in the Terai (where the natural gradient is very flat) often experience serious drainage problems: flooding and rise in groundwater tables are common. This renders the existing wastewater disposal system ineffective. These deficiencies obviously pose a serious threat to the health and sanitation of the residents. Hill municipalities also suffer from lack of drainage, although to a lesser extent than the Terai towns. According to ADB (2000), more than 25% of households of greater Kathmandu and 32% of those of Bhaktapur suffer frequent flooding.

Air Pollution

Air pollution is emerging as a serious concern in the major urban areas of Nepal in general and in Kathmandu Valley in particular (see Chapter 7). The deterioration in urban ambient air quality results from vehicular emissions, industrial emissions, burning solid waste including plastics, construction work, poor maintenance and narrow roads, and adulteration of fuel. In urban areas total suspended particles (TSP) and PM10 (particulate matter smaller than 10 micrometers in diameter) are the major concerns. Other pollutants such as SO_2 and NO_x are also increasing although still below Nepal's Ambient Air Quality Standards and WHO guideline levels. In areas where traffic is high, TSP and PM10 generally exceed national and WHO guideline values. This indicates that the major source of TSP and PM10 is road traffic; the condition of vehicles and of the road surface are contributing factors in addition to the type and quality of fuel. Industries probably follow as the next major source of urban air pollution.


NEFEJ

Industrial Air Pollution, Kathmandu

Air quality monitoring in Kathmandu shows that the air is routinely not clean enough to breathe in places like Putalisadak, Patan, and Thamel. Pollution also regularly obstructs the visibility levels of the scenic landscape of the Himalayas. According to a study, the number of foggy days in Kathmandu has increased from about 35–40/year in 1970 to more than 60/year in 1993, the most recent year for which reliable statistics are available (URBAIR 1996). Kathmandu Valley is particularly vulnerable to air pollution due to poor dispersion chances in its bowl-shaped topography. In the smaller urban areas, indoor air pollution resulting from use of biomass fuel, firewood, cow dung cake, and crop residues is at present of more concern than outdoor air pollution.

Adverse effects of air pollutants on human health can be acute or chronic. Respiratory infection is among the top five diseases in Nepal, occurring mainly due to prolonged exposure to smoke and dust (CBS 1998). Acute respiratory infections (ARI) continue to be one of the leading causes of death among young children, causing over 30% of deaths in children under five years of age (DOHS 2001). In Kathmandu Valley, 3.6% of the respiratory diseases among children are estimated to be caused by TSP (IUCN 1999). Air-pollution-related ailments such as pneumonia, bronchitis, and asthma are now becoming very common in Kathmandu Valley (IUCN 1999).

Traffic Congestion

The number of motor vehicles in the larger urban centers has increased rapidly in recent years. This has not been matched by provision of roads and infrastructure, leading to persistent traffic congestion, particularly in Kathmandu Valley towns. Urban development is taking place without adequate planning or provision of transport infrastructure, and with inadequate consideration of the nature and composition of the traffic. Urban roads are commonly narrow and crooked, and the road network function is poor. There is no or insufficient parking space. The mixture of vehicle types, poor driving, bad parking, and roadside trading add to traffic congestion. The consequences of this are longer travel times, greater levels of air and noise pollution, and less efficient fuel consumption (ADB 2000; Adhikari 1998; UNEP 2001).

Noise Pollution

Noise is becoming a significant form of pollution in urban areas. It is a public nuisance and affects people's health physically and psychologically (by increasing irritation, tension, nervousness, and anxiety). Transport noise, industrial noise, and community or neighborhood noise represent the leading forms of noise pollution in Nepal (IUCN 1991). Prolonged exposure to high noise levels may cause permanent hearing loss. Industrial noise is also a significant occupational hazard. Many noise-sensitive sites such as colleges and hospitals are also subject to much higher levels of noise than acceptable.

Like air pollution, noise is on the increase in municipal and industrial areas. Sources of significant noise include traffic, industries, use of heavy machines and tools in construction and commercial activities, and use of loudspeakers for prayer in the early morning hours. Conflicting land use in urban areas has contributed to noise pollution where residential use is mixed with noise-causing industries (ADB 2000). Transportation is one of the predominant sources of noise pollution. Power tillers, buses, heavy trucks, and three-wheelers are significant contributors to noise pollution in municipal areas (UNEP 2001). Road traffic noise levels in Kathmandu range from 70 to 100 decibels (dBA). The noise level in industries such as textile, metal works, cement, and flour mills is very high, with noise levels exceeding 90 dBA (IUCN 1999). People living around airports are subject to high levels of noise produced by aircraft.

Impacts on Heritage Sites, Open Spaces, and Agricultural Land

In the urban areas of Nepal, open spaces traditionally exist in the form of public/community spaces around cultural and heritage sites as well as in religious forested clumps and pond areas. In many smaller towns, open space also provides fortnightly, weekly, or bi-weekly market sites. Provision of public parks, playgrounds, and green open space, although found in a few urban centers, is not common in Nepal's urban planning and development.

Traditional open spaces are treated as "no man's land". Heritage sites and open spaces are under increasing pressure as haphazard urbanization continues. The historical and cultural sites are deteriorating due to pollution, emerging building has defaced historical and cultural monuments, and encroachment of the open space and premises of these sites is common (HMG/UNDP 1994; Adhikari 1998; IUCN 1999).

Urbanization invariably brings about land-use change. Loss or degradation of fertile agricultural land as a result of unguided urban development is a long-term concern. Urban areas of Kathmandu Valley have expanded at the cost of agricultural land. According to Karki (1998), between 1984 and 1994, the urban area in the valley increased from 3096 ha to 8378 ha and 5282 ha of fertile agricultural land was lost in the process of unplanned urbanization. If this trend continues, by the year 2020, all the prime agricultural land in Kathmandu valley will be urbanized. The loss of agricultural land in Kathmandu Valley is an important indication of what may happen in other urban areas as they grow haphazardly.

Policies and Initiatives

Policy

There is no specific policy for the urban sector in Nepal, although the significance of the urban sector rises consistently. Urban development is multisectoral and the urban policy thrust can be derived from the sectoral policies. The sectoral policies, plans, and related legislation and regulations provide a basic framework for urban development and environmental safeguards in urban areas. Some relevant legislation and policies include the following:

(i) Local Self-governance Act 1999: empowers municipalities to administer and manage local resources, and to prepare and implement programs. The Act is intended to develop municipalities as self-governing autonomous urban local bodies playing an effective role in overall urban development.

(ii) Town Development Fund Act 1997: facilitates financing of urban infrastructure projects in municipalities or urbanizing villages.

(iii) Solid Waste Management and Resource Mobilisation Act 1987: regulates collection, recycling, and disposal of solid waste in municipal areas.

(iv) Industrial Enterprises Act 1992: controls the establishment of industries and regulates licenses for establishment, expansion, and modernization of industrial enterprises.

(v) Environment Protection Act 1996: requires environmental assessment of proposed projects, empowers the Government to provide incentives to any activity that has positive impacts on the environment, and has provisions for polluters to compensate persons suffering from polluting activities.

(vi) Ancient Monument Protection Act 1956: protects ancient monuments and other

objects of archaeological, historical, and artistic importance, and empowers the Government to declare any area where an ancient monument is located as a Protected Monument Zone.

(vii) Nepal Drinking Water Supply Corporation Act 1989: sets up Nepal Drinking Water Corporation, a body responsible for supplying clean drinking water to municipalities and to areas specified by the Government, and to manage drainage systems in municipal areas.

(viii) Local Administration Act 1971, Land Acquisition Act 1977, and Vehicle and Transport Management Act 1992 have provisions that are relevant for urban management.

(ix) The National Solid Waste Management Policy, National Water Supply and Sanitation Policy, and Shelter Policy are important in the planning, development, and management of urban infrastructure.

(x) The Nepal Urban Sector Strategy 2000 is an important step towards recognizing the increasing significance of urban areas in Nepal.

While these policies and legislation provide a basic framework for urban planning and management as well as environmental safeguards in urban areas, there are difficulties at the implementation level. First, these acts need to be streamlined, made coherent, and ambiguities removed. Provision of urban infrastructure in Nepal has been largely driven by central institutions such as the Nepal Water Supply Cooperation; Department of Roads; Solid Waste Management and Resource Mobilisation Center; Nepal Telecommunications Corporation; and Nepal Electricity Authority. As responsibilities are scattered and many agencies are involved in the planning, provision, and management of urban infrastructure and services, coordination is extremely difficult. Institutional confusion arising from provisions in various legislations regarding the responsibilities, authorities, and handling of resources is a prominent issue. Urban development and management in Nepal lack an integrated holistic approach, and long-term vision. Recently, after enactment of the Local Self-Governance Act, municipalities are being increasingly empowered to manage their urban areas and to assume the urban governance role. The municipalities, however, are generally constrained by a lack of capacity and resources. As a result, urban areas of Nepal continue to grow spontaneously and haphazardly.

At present there is no information available regarding the level of investment by municipalities in the environmental and infrastructure sectors. However, solid waste management, building drains, and plantation are some areas in which municipalities commonly invest.

Lack of financial resources is a critical constraint currently faced by Nepalese municipalities. Local development fees (LDF) and grants are the two major sources of revenue for municipalities (Table 8.3). LDF are collected by the central Government and transferred to the municipalities through the Ministry of Local Government. Almost all municipalities are highly dependent on LDF and grants; they are generally weak in mobilizing local revenue sources. Bhaktapur municipality has introduced a "Tourist Entry Fee", which generated more than 44% of its revenue in one

Table 8.3: Consolidated Revenues and Ex penditures of Municipalities FY 2004

Revenue		Expenditure	
Heading	**Amount (NRs'000)**	**Heading**	**Amount (NRs'000)**
Own source		Current/administrative	
Local development fee	986,099	Salaries	465,030
House/land and propert y tax	142,044	Allowances	55,873
Other tax revenue	109,072	Services	52,978
Fees and fines	359,770	Fuel	50,538
Property rental	82,666	Contingencies	63,549
Other revenue	85,841	Other	147,043
Miscellaneous income	63,370	Debt payment	62,478
Grants (HMG, D DC,TDF, and other)	288,986	Social program	243,991
Loans	26,348	Ordinary capital (furniture, equipment)	35,150
		Capital investment (Public expenditure)	983,523

DDC = District Development Committee, HMG = His Majesty's Government of Nepal, TDF = Town Dev elopment Fund
Source: Chhetri and Pradhan (2005)

Land Pooling for the Proposed Outer Ring Road in Kathmandu

His Majesty's Government of Nepal and the People's Republic of China recently agreed to construct an "outer ring road" (approximately 66 km in length) in Kathmandu Valley. The current ring road was constructed 30 years ago also with Chinese assistance. The outer ring road (ORR) is expected to connect old settlements of Kathmandu Valley, provide space for a bulk supply line for the Melamchi Water Supply Project and for electricity transmission lines, and at the same time relieve traffic pressure in the main city areas by providing alternative by-passes. The road will have 60 m as right of way; space will be reserved for fast-track vehicles, bicycle track, water supply and electricity lines, and a green belt. Over 325 ha of land is thus required. Acquiring this land giving compensation at market rates would be too costly, and at the same time acquisition would take a long time due to compliance with the acquisition and compensation process. Keeping this in mind, a "land pooling" approach has been proposed to readjust the land with participation of the affected people.

Land pooling is a participatory process of land readjustment and development that has been practiced for urban expansion in Nepal for the past few years. Using this approach, a corridor of 560 m width (250 m left, 250 m right, and 60 m wide road) will be temporarily taken from landowners for development purposes. The land will be developed providing access, constructing basic infrastructure, and separating space for the road, service track, open spaces, and bicycle track. The land owners will contribute the space proportionately, based on defined criteria, and in return will receive developed plot(s) of land. The project expects that obtaining the land required for the road through land pooling in the 560 m corridor would help control urban sprawl, as the returned land would be developed. Critics of the project, however, feel that the outer ring road will further damage Kathmandu Valley by stimulating uncontrolled urban sprawling as has been done by the existing ring road constructed three decades ago.

Source : Personal communication with Mr. Kishore Thapa, Project Manager, Outer Ring Road Land Development Project; Devkota and Ghimire (undated); Joshi (2004); DUDH (2005)

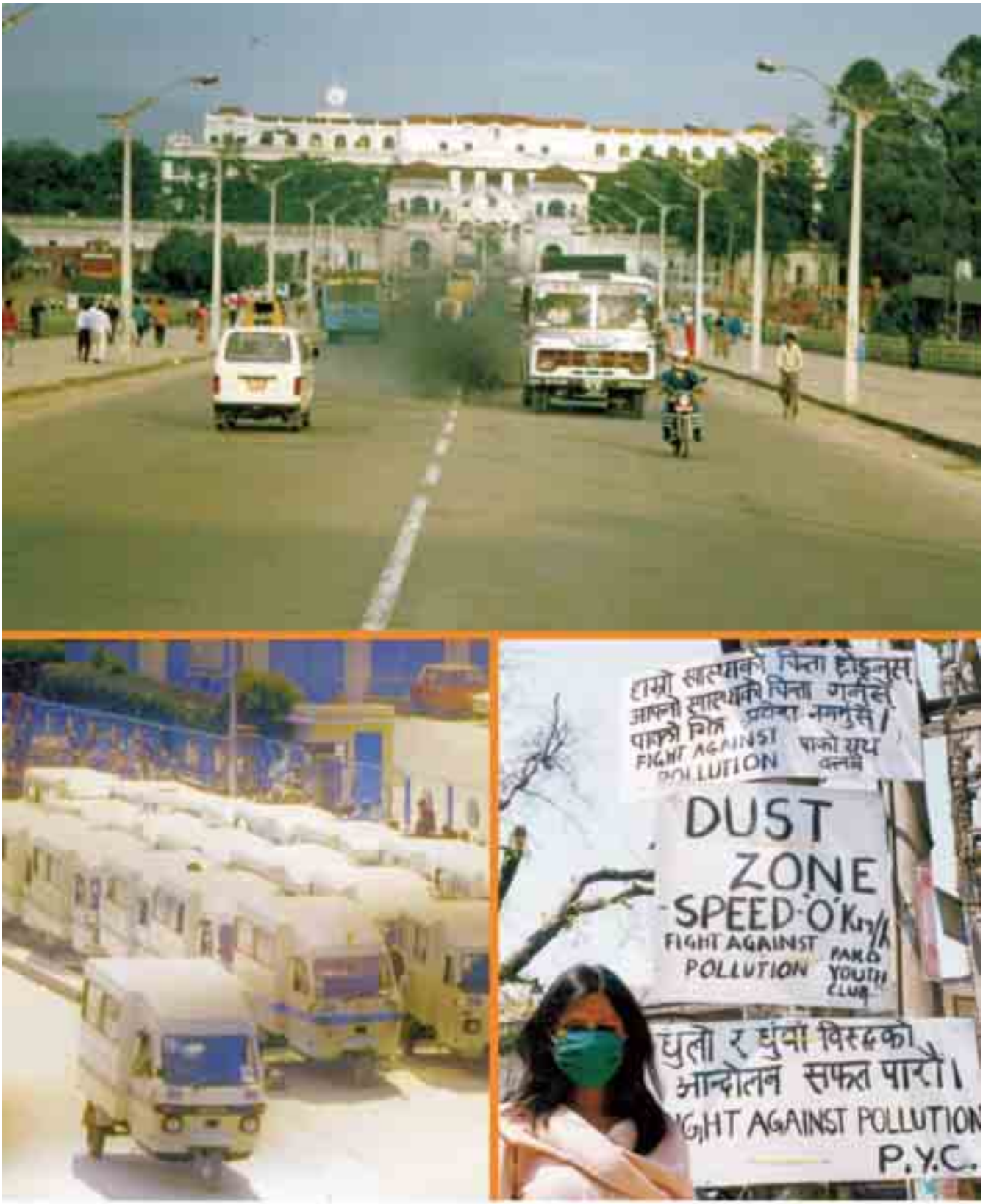
year (Chhetri 2004; Chhetri and Pradhan 2005). Nepal's accession to the World Trade Organization may require abolishing LDF, as this is against the spirit of the Organization. In the absence of LDF, municipalities will have further financial difficulties and many may be unable to cover administrative expenditures. Strengthening the financial resources of municipalities should therefore be at the top of the agenda of empowering and strengthening municipalities to meet environmental responsibilities.

There have been attempts in the past at planned development of urban areas. For example, Rajbiraj, Dipayal, Birendranagar, and Bharatpur were initially planned, but planning control quickly disappeared and they soon began to take haphazard routes to growth (Adhikari 1998). Tikapur town planning scheme, the only comprehensive effort to plan a new town in Nepal, was never implemented as envisioned (Adhikari 1998). Although master plans for Kathmandu have been prepared, implementation of these has been weak and generally unsatisfactory. Structure plans were prepared between 1988 and 1991 for all the 33 municipalities of the time. However, these were not adequate as the content was limited to general policy statements and details were not worked out (Joshi 2000).

Guided Land Development and Land Pooling are two notable government initiatives to plan and guide urbanization of some municipalities. These aim to facilitate adjustment of land plots in a participatory process so that space is provided for urban infrastructure—roads, water supply, drainage, electricity, and telephone. Integrated action planning is also practiced in several municipalities as an approach to planning urban areas by the people who live there. Community meetings are the cornerstone of this approach. Other features are mobilization and participation of the community in the identification, prioritization, and programming of municipal development activities and making the planning process more people oriented (Thapa undated; personal communication with the agencies concerned). Urban Development through Local Efforts is an initiative to strengthen municipalities in their roles and functions, and to promote participation by the people (UDLE 1992). There are several small-scale isolated initiatives in improving urban quality, e.g., in converting wastes into resources, and improving greenery (NEFEJ 2004).

Future Directions

The urban environment is broad and integrated and therefore urban environmental management should use a broad integrated perspective, rather than the conventional narrow approach of dealing with sectoral issues separately. There are obvious linkages among various urban infrastructures and services; synergistic positive effects could be enormous if these were to be integrated and coordinated properly. For example, solid waste management is linked with air pollution, functioning of drainage, public health, and aesthetics. A truly integrated and holistic approach should be promoted if urban



Min Bajracharya

B. Pradhan

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Vehicles are a major source of urban pollution: clockwise from top-bus in Kathmandu; protesting against pollution; clean SAFA tempos

environmental planning and management are to succeed in making urban areas better places to live. Obviously, this should not be limited to integrated and coordinated provision of infrastructure and services, but also include wider concepts of integration. It is necessary to:

(i) introduce land-use planning with due consideration to environmental attributes including urban ecology and heritage;
(ii) integrate and coordinate planning and management of urban infrastructure and services;
(iii) promote waste reduction, reuse, and recycling and other environmentally friendly practices;
(iv) raise awareness of people regarding environment, health, and appropriate practices and behaviors;
(v) promote participation and partnership with people, communities, NGOs, community-based organizations, the private sector, and civil society in environmental planning and management;
(vi) address urban poverty and needs of the urban poor; and
(vii) introduce the "polluter pays" principle.

Most past efforts in planning and providing urban infrastructure and services have been sectoral—uncoordinated rather than integrated. Important lessons regarding urban environmental management in Nepal can be derived from past activities including planning approaches and donor-supported programs as well as small-scale environmental activities of NGOs. The latter include converting wastes into resources (through composting, making briquettes from waste, paper recycling, management of solid waste by communities), promoting alternative approaches to waste/sewage treatment, and addressing the needs of the urban poor including those in slums and squatter communities. The informal sector can play an important role in urban life and livelihoods. Integrated urban management should also include strengthening this sector.

Municipalities, local bodies, and competent authorities must be strengthened if integrated urban environmental management is to be achieved. Appropriate tools, and human and financial resources must all be developed. Clear urban development policies and legal frameworks may be necessary for promoting land-use planning, participation by the stakeholders, and ensuring coordination and cooperation.

Quite often environmental problems are political and economic, arising not from shortage of environmental resources (e.g., land or fresh water) but from political or economic factors that inhibit certain groups' access to them. Most environmental problems cannot be solved without effective local institutions. In the long run, a competent, representative, inclusive, and democratic local government is the key for effective proactive environmental management in urban areas. Decentralization and empowering municipal governance are the top priorities if disjointed sectoral activities are to be coordinated under an able, technically competent, and financially viable urban management and development authority. To date, power lies with sectoral line agencies which control resources and influence legislation. This central control has not worked satisfactorily and is unlikely to improve in future. It is therefore essential for devolution of authority to take place in a very fundamental way, ensuring transfer of power and resources to local units, enhancing municipal capacity, ensuring participatory processes to working with communities, and fostering partnership with NGOs and the private sector.

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Chapter 9

Environmental Governance

Introduction

Governance is traditionally understood to mean control, rules, or administration by a state over society by the former exercising its power to direct, manage, and regulate citizens' activities in the best interest of the country. The United Nations Development Programme (UNDP) defines governance as the "exercise of economic, political and administrative authority to manage a country's affairs at all levels" (UNDP 1997). The quality of governance depends on the capacity and vision of the Government to design, formulate, implement, and monitor policies and to perform its duties.

Good governance is participatory, people-oriented, and involves government bodies, private sector agencies, social groups, communities, and the civil society at large in the process.

> It is transparent and accountable and honors rights of the people to participate in the decision making that affects their life. Critical aspects of governance denote different aspects of good governance. It is effective in making the best use of resources and it is equitable. It promotes the rule of law (UNDP 1997).

Good governance controls the misuse of natural resources and promotes their sustainable management and use. Good governance encourages local leadership and decentralization of power to the grassroots level and builds local capabilities. Good governance promotes sustainable economic development that is linked with the sustainability of the natural environment, and promoting conservation and sustainable use of natural resources to meet present needs without compromising the needs of future generations. Good governance includes implementation and evaluation of a country's commitments to different international environmental conventions, treaties, and protocols it has signed. It includes mobilization of requisite resources from different sources.

Environmental Governance in Nepal

Environmental governance in Nepal includes key elements of environmental policy and strategy planning; development and implementation of plans and programs at national and local levels; development and enforcement of environmental laws and regulations, norms, and standards; and establishment and operation of environmental institutions that supervise, execute, and monitor all aspects of the process. The judiciary imparts environmental justice to the citizens and safeguards those rights.

Environmental Policies, Plans, and Programs in Nepal

Planned development in Nepal has been ongoing since introduction of the First Five Year Plan in 1956. Since then, ten periodic national development plans have been implemented—one for three years (1962–1965) and the others for five years each. The most recent one, the Tenth Plan, covers the period from 2002 to 2007.[1]

The National Planning Commission (NPC), which is the agency responsible for formulating plans and policies on national and sectoral development, guides all socioeconomic development planning in Nepal. The 10th Five-Year Plan (2002–2007), clearly states that poverty reduction is and remains the cornerstone development objective of Nepal. Whenever possible, the NPC has attempted to integrate environmental issues with sustainable development and poverty reduction. Nepal has always recognized the value of protecting its natural resources. From the beginning of the 8th plan period (1992–1997), environmental issues have been consistently included in Nepal's socioeconomic development plans.

[1] Planning is carried out recording to the Nepali year, which starts and ends around mid April. Thus, for example, the plan for 2002 to 2007 is for five years from mid April 2002 to mid April 2007.

Table 9.1 describes the major highlights of Nepal's socioeconomic development plans from the environmental perspective.

The first three plans focused on natural resources conservation From the 4th Plan onward, environmental concerns were incorporated in sectoral policies. However, from the 5th Plan—the period following the 1972 Stockholm Conference, in which Nepal had participated—actions on preventing environmental degradation were initiated. During the 6th and 7th Plans, more concrete steps were taken towards safeguarding the environment through enforcement of environmental policies, encouraging participation of the private sector, civil society, and women's groups. From the 8th Plan period (1992–97) and especially following the Earth Summit on Environment and Sustainable development held in Rio, environmental considerations were firmly incorporated in the development process. The concept of sustainable development, advocating economic growth with sustainable resource utilization, was integrated in Nepal's

Table 9.1: Environmental Components of National Socioeconomic Development Plans (1956 –2007)

First Five-Year Plan (1956–1961)	Natural resources utilization, agriculture production. Forest Nationalization Act 1957 enacted.
Second Periodic Plan (1962 –1965)	Survey of natural resources, preparation of management plan for forestry of selected districts, forestation, forest demarcation, and promotion of forest -based industries.
Third Five-Year Plan (1965–1970)	Resettlement of Hill population in Terai, land management and cadastral survey, sedimentation and water flow measurements in Terai, master plan for drinking water and sewerage in Kathmandu Valley, and emphasis on water quality.
Fourth Five-Year Plan (1970–1975)	National and sectoral policies related to environment, programs of delineation of agricultural land, reclamation of forest land for resettlement, soil and land use surveys, watershed conservation in some parts of the country.
Fifth Five-Year Plan (1975–1980)	Emphasis on ecological balance , conservation of national forests and wildlife, reduction of urban pollution, promotion of ecotourism, encouragement to women's participation in environmental activities.
Sixth Five-Year Plan (1980–1985)	Emphasis on population control, watershed management, initiation of environmental impact assessment (EIA) of development projects, regulations on urban environment, environmental aspects included in land use policy.
Seventh Five-Year Plan (1985–1990)	Introduction of environment friendly policies and integrated environmental management, emphasis on participation of private sector, non-government organizations (NGOs), women, civil society for environmental management. National Conservation Strategy Master Plan for Forestry Sector endorsed.
Eighth Five-Year Plan (1992–1997)	Environment management policies integrated with sustainable economic development and poverty reduction, national environment policies and action plan reinforced to incorporate environmental issues with development planning. Establishment of Ministry of Population and Environment (MOPE). Preparation of EIA guidelines, improvement of legislative measures, promotion of environmental education, development of National Environmental Policies and Action Plan, inclusion of environmental aspects into hydropower, irrigation and industrial development policies, preparation and implementation of the Agricultural Perspective Plan initiated, Environmental Protection Act enacted.
Ninth Five-Year Plan (1997–2002)	Environmental Protection Regulations enacted, sustainable resource management principles endorsed, rural and urban environment problems differentiated, community -based forestry programs initiated, institutional strengthening of line ministries, legal provisions for national resource conservation and management, scope of biological diversity expanded, pollution control program introduced, involvement of civil society in municipal waste management, programs for environmental conservation, participatory environmental education, training and research programs on environment, development of environmental management information system. Programs of forest management and supply of forest products, introduction of market -based instruments for forestry management, water pollution control aspects addressed. Environmental standards on air, water pollution, and industrial effluents enforced.
Tenth Five-Year Plan (2002–2007)	Long-term goals of environmental management with better governance, pollution control, sustainable use of natural resources, emphasis on links between environment and economic development, public participation encouraged, internalization of environmental concerns into development plans and programs, implementation of national environmental standards, implementation of provisions of international environmental conventions, policies for capacity development of local institutions in environmental management , promotion of women's participation in environmental management at all levels, research on environment friendly technologies, legal and fiscal mechanisms for controlling industrial pollution introduced, adoption of appropriate strategies and working policies, natural disaster management policy introduced.

Source: Different plan documents.

development planning process. This period is characterized by concrete environmental actions undertaken by the country. These include such things as development of clear environmental policies, implementation of national environmental legislation, development of environmental action plans, and introduction of mandatory environmental assessment in infrastructure projects.

The key environment-related policies and strategies introduced to date include: National Conservation Strategy 1988; Industrial Policies 1992; Nepal Environmental Policy and Action Plan 1993; Tourism Policy 1995; Solid Waste Management Policy 1996; National Water Supply Sector Policy 1998; Revised Forest Sector Policy 2000; Hydropower Development Policy 2001; Nepal Biodiversity Conservation Strategy 2002; Leasehold Forestry Policy 2002; Water Resources Strategy, Nepal, 2002; National Wetland Policy 2003; Irrigation Policy 2003; and Sustainable Development Agenda for Nepal, 2003.

The Conservation Strategy endorsed by the Government in 1988 includes a number of programs to internalize the environmental impact assessment (EIA) system in Nepal. The strategy underscores the need to ascertain the potential consequences of development activities on the environment and to minimize detrimental effects. The strategy requires that project proponents identify the potential socioeconomic and environmental impacts of the project, and recommend ways in which these would be mitigated.

The Industrial Policy 1992 has emphasized measures to minimize adverse impacts on the environment during the establishment, expansion, and diversification of industries. The policy opens avenues to formulate guidelines and standards to check and minimize adverse effects of pollution associated with industrial growth. Industries that are likely to affect the environment have been categorized and a license is required to establish industries that affect public health and the environment (MOI 1992).

The Nepal Environmental Policy and Action Plan 1993, which was endorsed by the Environment Protection Council, was the first program to comprehensively articulate the environmental policies of Nepal—it listed seven:

(i) To manage natural and physical resources efficiently and sustainably;
(ii) To balance development efforts and environmental conservation for sustainable fulfillment of people's basic needs;
(iii) To safeguard national heritage;
(iv) To mitigate the adverse environmental impacts of development projects and human actions;
(v) To integrate the environment and development through appropriate institutions, adequate legislation and economic incentives, and sufficient public resources;
(vi) To foster environmental education and awareness at all levels; and
(vii) To facilitate participatory involvement of private sector, NGOs, international non-government organizations (INGOs), and civil society with government efforts in environmental protection.

The Tourism Policy 1995 emphasizes implementing environmental protection programs in an effective and integrated manner to promote sustainable tourism development. The need for developing tourism environmental guidelines and a local code of conduct concerning the environment is also discussed (MOCTCA 1996).

The National Solid Waste Management Policy 1996 underscores the importance of carrying out an EIA prior to selecting the final waste disposal site to reduce environmental pollution (MOLD 1996).

The Hydropower Development Policy 2001 envisages implementation of environmental management plans to minimize adverse effects of project development. The policy clearly requires that 10% of the annual minimum discharge or whatever level is recommended by the EIA study be maintained downstream in rivers (MOWR 2001).

The Nepal Biodiversity Strategy 2002 emphasizes conducting EIAs in accordance with the provisions of the Environment Protection Act 1996 and Environment Protection Regulations 1997 to assess impacts of development activities on biodiversity. The strategy has focused on ensuring effective implementation of existing laws on EIA (MOFSC 2002).

The Water Resources Strategy 2002 underscores the need for effective implementation of EIA and strategic environment assessment (SEA) norms and recommendations. The strategy has dissected environmental problems in the water resources sector and has emphasized implementing different environmental activities for management of watersheds and aquatic ecosystems. The strategy also calls upon the Ministry of Environment, Science, and Technology (MOEST) to take a lead role in developing environmental review and assessment tools and to advise the Government regarding required changes to the policies and implementation procedures of SEA and EIA (WECS 2002).

The Sustainable Development Agenda for Nepal 2003 prepared by the Government National Planning Commission defines sustainable development for Nepal and opportunities and broad goals covering

the period to up 2017. The document begins by describing the pathways forward, detailed objectives, and states necessary government policies. The agenda draws upon and is in conformity with the long-term goals envisaged in the Ninth Plan 1997–2002, the Tenth Plan 2002–2007, the Millennium Development Goals and the Poverty Reduction Strategy Paper, and commitments made by the country in various international forums (NPC 2003).

The Irrigation Policy 1993 (revision 1997) makes specific provisions and urges designing and implementing irrigation projects and programs based on the recommendations of EIA studies. Such reports should be prepared taking into account the National EIA guidelines 1993. The new Irrigation Policy 2003 has a working policy to identify and select irrigation projects that take into account environmental factors. The working policy emphasizes implementing projects by minimizing adverse environmental impacts, conducting initial environmental examinations (IEE) and EIA, and organizing public hearings, ensuring biodiversity conservation by mandating releasing of minimum essential water flows downstream, and utilizing water for irrigation by avoiding or reducing adverse environmental impacts (MOWR 1993).

The first major thrust to environmental conservation and management in Nepal was undertaken as part of the Eighth Five-Year Plan (1992–1997). The different policies and strategies initiated during the Eighth Plan were continued during the Ninth and Tenth plan periods. The Ninth Plan specified various key policy directives:

(i) Priority to environmental programs that involve women and the poor;
(ii) Special programs for environment conservation in remote areas;
(iii) Involvement of NGOs in environmental education;
(iv) Training and research on pollution control, solid waste management, and others;
(v) Development of environmental management information systems; and
(vi) Implementation of environmental standards.
(vii) It also emphasized developing alternative energy sources like solar, micro-hydro, and biogas plants as energy substitutes to replace forest products as fuel.

The ongoing Tenth Plan has accorded high priority to integrating environmental concerns into program implementation and has included a broad spectrum of working policies. The Tenth Plan has adopted the following working policies:

(i) To prevent degradation of natural resources, biological diversity, and cultural heritage;
(ii) To increase local participation in environment conservation, according to the Local Self Governance Act 1999;
(iii) Municipalities are to prepare and implement land utilization and waste management plans. Mandatory construction of sewage treatment plants while implementing city and settlement development plans. Take special initiatives in environment conservation, such as declaring plastic-free zones, provide aid to local authority through environment conservation trust;
(iv) Contribution of women's groups to environmental conservation will be encouraged;
(v) Different communities will be encouraged to improve their surrounding environment on the basis of self-awareness and motivation;
(vi) Improvements, conservation, and management of nationwide natural, cultural, and religious spots will involve local authorities. The role of nongovernment organizations, community organizations, and the private sector will be encouraged;
(vii) To mitigate environmental degradation in the lower regions by development activities in the upper regions (hydropower, irrigation) and to introduce rehabilitation programs;
(viii) Municipalities will be the designated institutions for vehicular emission testing and issuance of certificates;
(ix) Introducing monitoring and appraisal systems in the implementation stage of projects that have undergone environment impact assessment;
(x) A central mechanism will be established to coordinate different programs for implementation of international conventions relating to environment (e.g., climate change, desertification, Basel Convention on Hazardous Substances);
(xi) Air, water, and sound pollution standards will be determined and programs implemented giving emphasis to an effective monitoring system;
(xii) To manage and control industrial pollution, appropriate financial policies and legislative systems will be prepared and implemented;
(xiii) Environmental education will be integrated in formal and informal education, and necessary improvement in syllabuses will be made;
(xiv) To make environmental education effective, necessary acts and regulations will be formulated and reviewed;
(xv) Scientists, technicians, and researchers will be encouraged to promote new technologies in the area of environmental conservation;

(xvi) Priority will be given to implementing the Sustainable Development Agenda for Nepal 2003;
(xvii) Conservation-related traditional behavior, technology, and others will be documented and preserved. Likewise, an environmental information and database will be established and improved;
(xviii) To establish an environment conservation center under the ministry concerned emphasizing the utilization of human environmental resources;
(xix) Prepare conservation-related directives and methodology for the World Trade Organization and make exports eco-friendly.
(xx) Emphasize an integrated development plan on the basis of the interrelationship between highlands and lowlands;
(xxi) To control the environmental impacts from glacial lake outburst floods, necessary studies and research will be conducted, including monitoring of different variables related to climate change;
(xxii) Different strategies will be formulated for the environmental management of the industrial, forestry, and agricultural sectors and river systems;
(xxiii) Different action plans will be formulated and implemented regarding management of different groups of urban wastes under a solid waste management program;
(xxiv) Necessary programs will be implemented in coordination with related agencies for the conservation and sustainable utilization of the Bagmati, Bishnumati, and Manohara rivers inside Kathmandu Valley; and
(xxv) Utilization of renewable energy sources will be encouraged.

The major working plans and programs approved by the government and incorporated in different development plan documents (see Table 9.1), that support the delivery of environmental objectives include the National Forestry Plan 1976; Forestry Sector Master Plan 1989; Master Plan for Livestock 1991; National Environmental Policy and Action Plan 1993; National Biodiversity Action Plan 1995; Agriculture Perspective Plan 1995; National Plan of Action on Habitat 1996; National Action Program on Land Degradation and Desertification 2004; and National Water Plan 2005.

In addition to the above, community forestry programs initiated in 1993 (MOFSC 1993a) have been expanded to almost all parts of the country. As of March 2000, about 0.65 million ha of national forests have been handed over to more than 9,000 community forestry user groups. About 1 million local people directly benefit from this process.

Based on the experience of community forestry, the Government has also started soil conservation and watershed management activities with people's participation. A participatory watershed management system is in place in a number of districts for the conservation and rehabilitation of degraded watersheds. Community groups are now actively involved in terracing and conservation plantation on degraded hill slopes, and in water source protection.

User groups have also been mobilized to manage the buffer zones of the Terai national parks and reserves since the mid-1990s. This approach has been expanded to all the protected areas in the country (9 National Parks, 3 Wildlife Reserves, 3 Conservation Areas, and a Hunting Reserve) in a phased manner. Local user groups have been instrumental in managing Nepal's conservation areas and utilizing natural resources for community development in a sustainable manner (MOFSC 1996).

The Government introduced a vehicular pollution control program in 1996. Vehicle mass emission standards were introduced in 1999 and in 2000. The Government has also established monitoring stations to ensure regular monitoring and evaluation of pollution levels in Kathmandu Valley.

The Tenth Plan has also incorporated strategies, policies, and working programs for the management of natural and human-induced disasters in the country. The objective is to ensure security of human lives and property by managing natural and human-induced disasters systematically and effectively and by making the development and construction related programs sustainable, reliable, and gainful. While formulating plans and policies on disaster management, emphasis will be given to the use and development of technologies that lessen harm to the environment. The relief and rescue activities provided by the state will be made transparent. Programs will enhance awareness regarding disaster management. The Seismological Measurement Center and the Natural Disaster Management Center will be strengthened (NPC 2002).

The Tenth Five Year Plan has envisaged several plans for disaster management. These include an integrated information system to coordinate the efforts of national and international organizations working in disaster management; a central database system at the center and district database systems in the districts; storing disaster relief materials in storage centers in all five regions; preparation of geological maps of the country; identifying areas that can be affected by natural disasters; collecting information and updating the catalogue of

earthquakes; and awareness raising programs about possible damage from water-induced disasters. In addition to preparing hazard maps, application of geo-engineering and the use of geo-environmental maps will be undertaken to regulate physical infrastructure development and disaster management and carry out relief programs for people affected by disasters.

Effectiveness of Environmental Policies, Plans and Programs

Although the Government has accorded a high priority to resolving environmental problems and has formulated comprehensive sets of policies, plans, and programs, their effectiveness has been below expectations. These policies have failed due to inadequate focus on cross-cutting issues, continuous intervention by political parties, the inability of national advisory bodies to function properly, the inability of policy institutions to implement policy, and most important, lack of adequate resources. Key national agencies like the NPC and sectoral ministries have not been proactive in implementing approved policies and programs, and the Government has failed to attract the participation of the private sector. In this regard it is worth mentioning that under grant assistance from the Asian Development Bank (ADB), a study was conducted by MOPE in cooperation with the Bank on institutional strengthening of the Ministry of Population and Environment (MOPE) which was completed in 1999. However the recommendations of the study report were never implemented (ADB and MOPE 1999).

Monitoring of project implementation has been poor. Moreover, the key environmental body until recently was MOPE, which was never funded to the extent needed to fulfill its mandate. Similarly, sectoral agencies were unable to fully implement regulations due to lack of funds and inadequate infrastructure capacity. Those agencies whose main mandates were not environmental had only enough capacity to fulfill their own priorities, so environmental requirements were relegated to second place and, more often than not, left unattended.

The political instability that has plagued Nepal for the last 14 years has also played a role. Agencies have found it difficult to address environmental problems comprehensively because of frequent changes in senior staff and political interference in program implementation (NPC 1997).

Regulatory Framework

Legislation

The Constitution of the Kingdom of Nepal, 1990 (Part 4 Article 26: State Policies) stipulates the following principles:

(i) The state shall pursue a policy of mobilizing the natural resources and heritage of the country in a manner useful and beneficial to the interest of the nation; and

(ii) The state shall give priority to the protection of the environment and also to the prevention of its further damage due to physical development activities by increasing the awareness of the general public about environmental cleanliness, and the state shall also make arrangements for the special protection of rare wildlife, forest, and vegetation.

The Environment Protection Act 1996 and the Environment Protection Regulations 1997 are the two main legal documents providing for environmental information and public participation in the EIA process. The Act and Regulations provide a legal basis for protecting the environment and controlling pollution. They propose measures for pollution control through permitting environmental inspection, establishment of environmental laboratories for monitoring pollution and conservation, creation of an environmental protection fund, and an environment protection council, providing incentives to business, and awarding compensation for adverse environmental impacts.

The Local Self Governance Act 1999 provides more autonomy to village development committees (VDCs), district development committees (DDCs), and municipalities by empowering local authorities to manage natural resources, and guides them to integrate environmental resources and environmental planning. Highlights pertaining to environmental governance include the following:

(i) The Act requires wards to help in protection of environment through plantation and stipulates the rights and duties of the VDC;

(ii) It empowers VDCs to levy taxes on utilization of natural resources;

(iii) It provides powers to formulate and implement plans for conservation of forest, vegetation, biological diversity, and soil; and

(iv) It provides power to formulate bylaws in the area of management of all natural resources.

Standards

Most of the existing environmental standards and norms were developed and put into effect during the

1990s. EIA guidelines were developed by the NPC in 1993 and legitimized by MOPE in compliance with the provisions of the Environment Protection Act 1996. These standards serve as national norms for mitigation of environmental damage caused in the construction of development projects. In addition, norms prescribed by different line agencies help implement infrastructure projects in an environmentally conscious manner. The Foods Department under the Ministry of Agriculture and Cooperatives has developed specific quality standards under the prevailing Food Act 1967 that include guidelines for 87 edible products (MOAC 1967). Similarly, the Department of Electricity Development under the Ministry of Water Resources has developed safety standards for the construction of hydropower projects; the installation and operation of electromechanical equipment, transmission, and distribution systems; the operation of hydropower dams; and others. These standards also have mandatory provisions for the protection of the surrounding environment, including the protection of aquatic and animal life. In cases where standards are still being developed (such as national standards for drinking water), World Health Organization (WHO) or other standards are being applied in the interim. Details of some environmental standards developed by different public sector agencies of Nepal are provided in Appendix 9.1.

International Commitments

To date, Nepal is a signatory or party to 21 environment-related conventions and is obligated to fulfill its commitments to them at national and global levels. The seriousness of Nepal's commitments to these conventions has been demonstrated over the past 10–15 years by the enforcement of relevant policies and strategies, by the establishment of an institutional and regulatory framework, and by the implementation of different environmental programs. In particular, the Ninth and Tenth Five-Year Plans have reflected strong commitments to prioritize and implement provisions of the international treaties/conventions on the environment.

Nepal is actively involved in the following conventions: United Nations Framework Convention on Climate Change; Vienna Convention on the Protection of the Ozone Layer; Convention on Biological Diversity; UN Convention to Combat Desertification; Convention on International Trade in Endangered Species of Wild Flora and Fauna; Ramsar Convention on Wetlands; International Tropical Timber Agreement; and Convention on Persistent Organic Pollutants.

Many activities are being carried out to implement programs related to these conventions. This is taking place at the national level by different government agencies like MOEST, the Ministry of Forest and Soil Conservation (MOFSC), and NPC, and other stakeholders in cooperation with various NGOs, INGOs, and experts on relevant subjects under financial and technical assistance from multilateral and bilateral organizations (MOPE 2002). One such example is the joint study by MOPE and the Department of Hydrology and Meteorology with support from United Nations Environment Programme (UNEP) on enabling activities for the preparation of the initial communication related to United Nations Framework Convention on Climate Change (MOPE 2002). The Environment Sector Program Support (ESPS) project conducted by MOPE from 2001 to 2005 with Danish International Development Agency (DANIDA) support, which included institutionalization of environmental management aspects, industrial water treatment activity, and improvement of energy efficiency of industries for cleaner production, is another example. Similarly a study was conducted by MOPE on institutional strengthening of the EIA process for hydropower development in Nepal with the Norwegian Agency for Cooperation and Development (NORAD) support during 2002–2004.

The results of such studies are contributing to the updating of relevant data and information and are helping to improve plans and programs for environmental management at the national level. They are also serving as useful inputs for information sharing with the international community.

Unfortunately, procedural delays are common in the ratification of some important international environmental treaties and conventions, and their obligations are not being fulfilled on time. For example, although Nepal is a party to around 21 environment-related international conventions and treaties, it has only been able to ratify a few of them so far. The major reason is the failure of the agencies concerned to understand the technical aspects of the subject. Other reasons include a lack of initiative and capacity on the part of MOPE, which until 2005 was the key agency responsible for environmental administration. Ideally, the policymaking agencies concerned and key environmental bodies of the Government should review the status of these commitments and coordinate their actions to comply with their obligations.

A list of the major international environmental conventions in which Nepal has participated, together with their related obligations and status of implementation, is provided in Appendix 9.2.

Sub-regional Linkages

Other developing countries in the region have also been encountering serious environmental problems. Many countries are experiencing the same challenges of developing legislative and institutional frameworks appropriate to their conditions. It might be beneficial for Nepal to establish linkages with the relevant environmental institutions of these countries. Such exchanges of information and experiences on the successes or difficulties of planning and implementing environmental programs would further enhance capacity building in this area.

South Asian Association for Regional Cooperation (SAARC) has been a very useful forum for this. The South Asia Cooperation for Environment Program (SACEP) and UNEP have also taken many initiatives to promote regional cooperation in South Asian environmental management. For example, UNEP has been supporting South Asian countries in conducting different activities related to understanding climate change and devising measures to combat their impacts. Similarly, SACEP has been conducting studies and preparing handbooks on national environmental legislation and institutions for these countries under the UNEP/SACEP/NORAD publication series on environmental law and policies (UNEP et al. 2001).

In recent times, the need for well-established linkages between energy, the environment, and the economy has been recognized strongly in South Asia. In this context Nepal can also benefit from regionalizing its environmental activities.

Enforcement of Environmental Laws and Standards

Nepal's environmental laws can be broadly divided into two categories. The first includes laws directly designed as legal provisions for the protection of the environment and conservation of natural resources; for example, the Environment Protection Act 1996 and its Regulations 1997, National Parks and Wild Life Conservation Act 1973, Soil and Watershed Conservation Act 1982 and Regulations 1985, and EIA Guidelines 1993. The second category includes those directly or indirectly influencing the environmental protection process but aimed at promoting and managing sector-specific development programs such as the Forest Protection Act 1967, Industrial Enterprises Act 1992, Pesticides Act 1991, Solid Waste Management and Resource Mobilization Act 1987, and Vehicle and Transport Management Act 1992 and its Regulations 1997. All acts have to be approved by Parliament on recommendation of the Government, while the Government, on recommendations of the respective ministries, approves regulations defining detailed procedures for implementation of the respective acts.

Legal provisions in the first category including the Environment Protection Act and Regulations, and EIA Guidelines are directly enforced by MOEST which also monitors their application. The legal provisions of laws in the second category are enforced and their application monitored by the respective ministries. For example, rules and regulations related to the use of pesticides are enforced and monitored by Ministry of Agriculture and Cooperatives; regulatory instruments related to forestry, biodiversity, and similar are enforced and monitored by MOFSC; and legal provisions under the Local Self Governance Act 1999 are enforced and monitored by local government bodies like DDCs and VDCs. Similarly, some key environmental standards developed by MOEST are enforced by MOEST itself, whereas sector-specific environmental standards are developed and enforced by the respective ministries. Regulations and standards on control of urban wastes are developed by MOEST and enforced by the municipalities. However, MOEST has also been empowered to cross check and monitor implementation of sector-specific laws and compliance of standards.

Lack of inter-agency coordination, inadequate skilled personnel, poor and weak mechanisms of control and supervision, inefficiency of public administration, lengthy decision making processes, lack of coordination between the Government and NGOs, instability of the Government, lack of appropriate technology, illiteracy, and lack of mass awareness are some of the major reasons for weak enforcement of environmental legislation. The difficulties associated with effective enforcement of legislative instruments stem from the fact that MOEST and other sectoral agencies are fragmented in their approach to monitoring. Monitoring is weak and uncoordinated, strict measures for enforcement are lacking, and non-compliance is rampant. Prior to formation of MOEST[2] in 2005, MOPE was the key government body on environment in Nepal. However, MOPE was not successful in enforcing environmental laws and regulations in the country. Moreover MOPE remained weak in monitoring and evaluating the environmental performance of other environment related agencies. These agencies also

[2] MOEST was formed in 2005 by annexing the Environment Division of the former Ministry of Population and Environment (MOPE) and joining it to the then existing Ministry of Science and Technology (MOST), which was then restructured into MOEST.

have roles to play in some aspects of monitoring. However, here the problem is even worse, since environmental monitoring is not their main mandate. Besides they also face scarcity of funds. These agencies are more occupied with achieving their own agendas than ensuring that environmental requirements are complied with. For them environmental matters are usually of secondary importance if any at all (MOPE and ESPS 2003). For example, the Ministry of Industry, Commerce and Supplies has been more concerned with meeting their targeted product outputs than with complying with the environmental standards prescribed by MOEST (and before that MOPE) for industries. Collecting all the legal instruments scattered through multiple sectoral bodies into a single common legislation might rectify some aspects of this situation.

The Environment Protection Act and Regulations, and SEA and EIA procedures are themselves in need of updating and modification to keep them relevant to changing demands. At the same time, major existing provisions of IEE and EIA prescribed in the Environment Protection Act and Regulations are unclear and not comprehensive and require revision. Due to lack of funds, implementation of EIA provisions has not been effective. In the meantime national coordinating bodies like NPC and the Environment Protection Council are not paying the necessary attention to strict enforcement of legal provisions of EIA by different agencies. From the Tenth Plan, the NPC has introduced the concept of SEA, which could be very useful for environmental screening and proper planning of sectoral programs; however, the process still needs to be properly institutionalized and adequately documented. As a result of inefficiencies throughout the system, the implementation of environmental guidelines is often delayed.

Major Stakeholders

The environmental institutions in Nepal include different public and private sector stakeholders that can be categorized broadly as follows.

Judicial bodies. The Supreme Court, Appellate and District courts.

Advisory bodies. National Development Council, NPC, National Water Resources Development Council, Environment Protection Council, National Commission on Sustainable Development, Water and Energy Commission, National Biodiversity Coordination Committee, and others.

Policymaking bodies. Parliamentary Committee on Environment Conservation; line ministries including Ministry of Environment, Science and Technology; Ministry of Forest and Soil Conservation; Ministry of Physical Planning and Works, Ministry of Water Resources; Ministry of Industry, Commerce and Supplies; Ministry of Local Development, Ministry of Defence, Ministry of Home Affairs; Ministry of Agriculture and Cooperatives; and Ministry of Labour and Transport Management. Policymaking bodies also include the Department of Hydrology and Meteorology, Nepal Bureau of Standards and Metrology under the Ministry of Industry, Commerce and Supplies, and the Central Food Research Laboratory under the Ministry of Agriculture and Cooperatives.

Corporate and local bodies. Nepal Electricity Authority; Nepal Agricultural Research Council, Royal Nepal Academy of Science and Technology, Solid Waste Management and Resources Mobilization Center, Nepal Water Supply Corporation, DDCs, VDCs and metropolitan and municipality administrations.

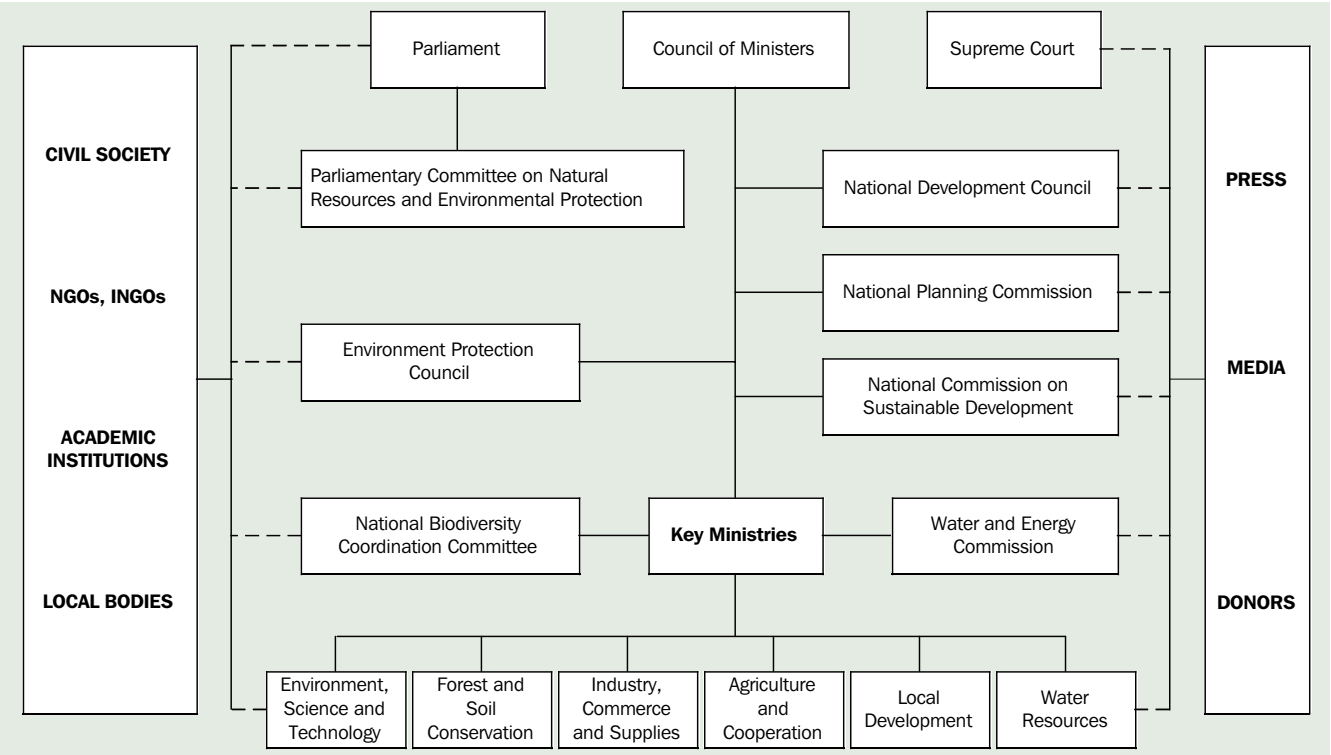
Private sector organizations and NGOs. Federation of the Nepalese Chambers of Commerce and Industries, statutory NGOs such as King Mahendra Trust for Nature Conservation, and other NGOs (see Appendix 9.3) registered under the Association Registration Act and affiliated with the Social Welfare Council; Federation of Community Forestry Users, Nepal; and Federation of Water Users Associations, including various community-based organizations and professional societies.

Academic institutions. Kathmandu University, Tribhuwan University, College of Information Technology, and School of Environment Management Systems based in Kathmandu are contributing towards the preparation and training of environmental professionals.

The media. The media in Nepal has been very active in bringing issues and problems of environmental concern to the public's attention and this has contributed to better and continued surveillance. Media focus has also prompted relevant government and private agencies to undertake projects aimed at environmental improvement. Frequently published articles in dailies like Kantipur, The Kathmandu Post, The Himalayan Times, and Nepal Samachar Patra, and other popular weekly publications like the Nepali Times, Himal, and Spotlight, as well as media programs conducted by agencies like the Nepal Forum for Environmental Journalists and Society of Environmental Journalists Nepal serve as examples.

Civil society. With heightened and improved awareness, civil society has in general demonstrated its serious concern for the environmental situation of the country and has been proactive in supplementing the Government's efforts to bring about improvements.

Figure 9.1: The Key Environmental Institutions in Nepal



INGO = international nongovernment organization, NGO = nongovernment organization
Source: Compiled from various sources

In spite of this large number of stakeholder institutions and good intentions on the part of all concerned, performance on environmental matters remains poor. The most serious impediment to progress on environmental issues remains the lack of inter-stakeholder coordination. This lack of coordination has led the different agencies to work in isolation and has impeded addressing environmental management in a holistic manner. Stakeholders need to be networked and streamlined to maximize benefit from their joint efforts. The hierarchical linkages of key environmental institutions are shown in Figure 9.1.

Role of Key Environmental Stakeholders

Parliamentary Committee on Natural Resources and Environmental Protection

The Parliamentary Committee on Natural Resources and Environmental Protection provides guidance to and oversees government actions in initiating natural resources conservation and environmental protection. As a legislative body, the Committee also has authority to give directives to, and seek information and clarification from, the executive branches of the Government on natural resources and the environment. The committee is headed by an independent chairperson elected from among the members of Parliament.

National Development Council

The National Development Council is the highest policy-level body of the country and is chaired by the prime minister. The council is mandated to provide guidance over major policy issues and periodic plans, including all aspects of natural resources conservation and environmental protection. It is composed of all cabinet ministers, all members of the NPC, chairpersons of the various parliamentary committees and selected chairpersons of the DDCs, and the leader of the main opposition party in the house, as well as other prominent parliamentarians, representatives of key private sector organizations, and intellectuals. The NPC serves as the secretariat of the Council.

Environment Protection Council

The Environment Protection Council is a high-level national body focusing on management and protection of the environment; it is chaired by the prime minister. It was established in 1992 and comprises ministers of relevant ministries, senior civil officials, representatives of NGOs and the private sector, and individual environmental professionals. MOEST is the secretariat of the Council.

The Council provides guidance on the formulation of environmental policies, their legal framework, procedures, and policy implementation. It provides guidance on the management of natural and physical resources and coordinates environmental activities among the relevant national agencies, taking into account the EIA of project developments, dissemination of information on the environment, and promoting environmental awareness and education.

Judiciary

The judiciary is the guardian of the constitutional and legal system of a country. It is responsible for the protection of constitutional and legal rights. Most of the legal norms related to sustainable development concern people's basic rights like the right to development, right to information on the exploitation of natural resources, right to a healthy environment, right to participate in decision making, right to a fair and equitable share of the fruits of development, and so on. When the judiciary plays an effective role to protect these rights, it leads towards achieving sustainable development (HMG 1990).

Nepal has a pyramid judicial structure, with a single Supreme Court at the apex, 11 Appellate Courts, and 75 District Courts. Under the Constitution, the King at the recommendation of the Judicial Council appoints Supreme Court judges, a body composed of senior judicial officers. Supreme Court judges can only be removed on the stated grounds pursuant to a determination by a two-thirds majority of a sitting House of Representatives. The Judicial council may remove lower court judges from office following a recommendation to that effect. The Act also provides for independence of the judiciary.

The Judiciary has promoted the development and enforcement of legal norms in the field of sustainable development by exercising its powers under Part 11 of the Constitution and by the provisions of other Acts and Regulations adopted by the Government from time to time (HMG 1990). Article 88 (2) of the Constitution has conferred such powers to the judiciary, which are extremely important for the enforcement of legal norms related with sustainable development.

National Planning Commission (NPC)

Chaired by the prime minister, the NPC is an autonomous government body charged with formulating all national and sectoral policies, and development of periodic plans, as well as short-term and long-term plans and programs. The Government appoints the members of the NPC, including the vice-chairman. It has an environment division headed by one of its members responsible for policy planning, programming, budgeting, monitoring, and review of all environment-related activities in the country.

Ministry of Environment, Science and Technology (MOEST)

MOEST was established as a new Ministry mandated to carry out environmental activities early in 2005 following dissolution of the Ministry of Population and Environment (MOPE). After the establishment of MOEST, the environment division of MOPE was moved to this Ministry.

MOPE had been created in September 1995 to act as the focal point for the interrelated areas of population and environment. Its main responsibilities included (i) formulation and implementation of policies, plans, and programs; (ii) preparation of acts, regulations, and guidelines; (iii) undertaking surveys and research studies; (iv) dissemination of information; (v) monitoring and evaluating programs; and (vi) human resources development for the environment sector.

MOPE's scope of work included two broad categories of activities: primary and supportive. Primary functions included activities executed on the initiative of the ministry in cooperation with other agencies. Cooperation and assistance extended to other ministries and agencies in executing their own programs and activities are the supportive functions.

With the environment division now moved to MOEST, MOEST has taken over all the environmental functions of MOPE.

Ministry of Forest and Soil Conservation (MOFSC)

The MOFSC is responsible for formulating and implementing plans, policies, laws, and programs for the conservation of forest resources and their management; as well as for administering and monitoring their implementation. The ministry also prepares guidelines and manuals for forestry development, conservation and protection of biodiversity and wildlife, soil conservation, watershed management, and protected areas.

MOFSC operates through five central departments and a research center.

(i) The Department of Forest administers the forests and rangelands throughout the country, which account for about 47% of the total area of Nepal;

(ii) The Department of Plant Resources is responsible for botanical research on forest species and their promotion;

(iii) The Forest Products Department Board promotes the economic and sustainable utilization of wood, medicinal and aromatic

plants, and other non-timber forest products by developing suitable technologies and processes for utilizing such products;

(iv) The Forest Survey and Research Center acts as an autonomous body in conducting forestry related research and surveys;

(v) The Department of National Parks and Wildlife Conservation is responsible for the management of the national parks and protected areas as well as biodiversity conservation; and

(vi) The Department of Soil Conservation and Watershed Management bears responsibility for carrying out soil conservation activities and watershed management.

The ministry has offices in all 75 districts, and regional offices to conduct different activities related to development and management of the forestry sector.

Ministry of Industry, Commerce and Supplies

The Ministry of Industry, Commerce and Supplies is responsible for promoting industry in the country without compromising environmental management. The ministry controls industrial pollution in both new and existing industries. It is also responsible for preparing and enforcing legislation and regulation on industrial pollution, water discharges from industries, and developing industry-specific discharge standards for air and waterborne environmental contamination. A separate unit on Environment and Technology Transfer also exists within the ministry.

Operating under it are the Department of Industry, the Department of Cottage and Small Scale Industries, and the Cottage and Small Industry Promotion Board. The Department of Industry and the Department of Cottage and Small Scale Industries have environment units for enforcing discharge standards, applying IEE and EIA to industries, issuing permits for industrial establishments, and monitoring emissions and effluent discharges.

The Nepal Bureau of Standards and Metrology, under the ministry, is responsible for setting standards for air, water, and other environment-related components. It also enforces the above standards and fixes effluent and emission standards for industries and motor vehicles.

Ministry of Local Development

The Ministry of Local Development is responsible for formulating policies, plans, and programs on rural and town developments and monitoring their implementation, taking into consideration their environmental implications. The ministry also implements the environmental provisions made in the Local Self Governance Act 1999 through its local organs and local bodies like DDCs and VDCs in collaboration with local communities and user groups.

Ministry of Agriculture and Cooperatives

Besides its main jurisdiction of agriculture and livestock development, the Ministry of Agriculture and Cooperatives is responsible for formulating policies, standards, and legal instruments related to environmentally sensitive products and control of agricultural pollution. It operates through its regional and district offices in all five development regions and 75 districts. The key entities under the ministry are the Nepal Agricultural Research Center, the Department of Agriculture, the Department of Livestock Services, Nepal Tea and Coffee Development Board, the Dairy Development Board, and the National Seed Development Board. The Central Food Research Laboratory under the ministry implements the Food Act 1966, the Animal Feed Act 1976, and corresponding regulations.

Ministry of Water Resources

The Ministry of Water Resources is responsible for all activities related to the development of water resources, electricity, irrigation, alternative energy development, and management of water-induced disasters. The ministry has an independent policy-planning wing—the Water and Energy Commission Secretariat—responsible for planning of water resources based on strategic environmental evaluation and assessment of environmental impacts of the water development projects. The Commission Secretariat developed a comprehensive Water Resources Strategy for Nepal in 2002 and a National Water Plan for implementing its provisions in 2004 (WECS 2004) giving high priority to environmental concerns and their management as an indivisible part of all these plans and programs. The ministry also has an environment division responsible for identification and management of environmental implications of water resources development.

Nepal Electricity Authority

The Nepal Electricity Authority is a semi-government public utility responsible for the generation, transmission, and distribution of electric power throughout the country. It operates through six directorates and 12 departments and has field offices in almost all 75 districts of Nepal, engaging around

10,000 employees at different levels. The Nepal Electricity Authority is the key agency for construction and maintenance of power projects (mainly hydro-based). It contains a well-established environmental directorate with around 25 officers and support staff. EIA of all hydro projects has been made mandatory in the project development process. Environmental management plans of all projects are executed under the supervision of this directorate.

Ministry of Physical Planning and Works

The Ministry of Physical Planning and Works has two major wings—one for construction of roads and highways, another for extension of water supply and sanitation projects. The Water Supply and Sanitation Department develops rural water supply schemes and hands them over to community water users, while the Nepal Water Supply and Sewerage Corporation, established in 1998, is responsible for water supply and sewerage schemes in urban areas, mostly municipalities. The ministry itself and all departments under its supervision have environment divisions headed by senior officials, some of them environmentalists. The Melamchi Water Supply Scheme is being developed for diversion of 170 million liters of water per day from the Melamchi river (Sindhupalchowk district) to Kathmandu Valley. A special division is responsible for supervising and implementing all environmental programs envisaged in the project.

Similarly, the roads department of the ministry is responsible for constructing and managing roads and highways, giving due priority to environmental aspects. It takes into consideration the EIA and implementation of environmental management plans at planning, executing, and maintenance stages. These are being managed by the geo-environmental division of the department.

Municipalities

Kathmandu Metropolitan City has a population of about 1.8 million people (CBS 2002). Major environmental problems in Kathmandu Valley include solid waste disposal, air and water pollution, unmanaged slums, and shortage of potable water. Degraded sanitary conditions are causing health and other problems. The city created an environment division in 1997 which carries out environmental management and conservation programs within the metropolitan area. The key functions of the environment division are solid waste management, participation in urban environmental management —including air pollution control and sewage management—and development of green areas within the metropolitan area. It conducts its activities in collaboration with MOEST, the Nepal Tourism Board, and other environmental NGOs active for environmental improvement of Kathmandu Valley.

The other two sub-metropolitan cities of Kathmandu Valley, Lalitpur and Bhaktapur, have also created environmental sections to implement and monitor environmental programs within their jurisdictions.

Other large municipalities in the country outside Kathmandu Valley have also initiated environmental management programs.

Overall Performance of Environmental Governance

Environmental governance refers to the functioning of stakeholder organizations under the framework of prevalent rules and regulations to deal with environmental problems. Environmental governance in Nepal has not been very effective.

Key reasons for ineffective environmental governance in Nepal have been the frequent changes in governments, government's poor functioning, and inadequate attention paid to the increasing urban and rural environmental problems. Others include absence of long-term environmental policies, weak enforcement of environmental laws, malfunctioning of national decision- and policymaking bodies, inability of environmental institutions to streamline activities into the national socioeconomic development process, insufficient funding, and low morale. These deficiencies have been compounded by inefficient public administration in general, weak monitoring, non-responsiveness of the environmental agencies to public opinion, and non-execution of recommendations of many studies conducted for the environment sector through donor support.

The Government has created and dissolved environmental institutions frequently, without providing them sustainability or continuity, being guided mainly by political motivations. This has brought instability and distortion to the process of environmental governance. One of the most recent examples of such change was the dissolution of MOPE in 2005 after 10 years of existence and annexation of its environment division to MOEST. Some think it might have been more effective to restructure MOPE and strengthen it to maintain its independent identity and improve its performance.

Institutional and regulatory efforts in Nepal towards the conservation of natural resources and management of environmental issues have had little impact due to the different factors and constraints encountered. The underlying reasons for poor

environmental governance can be better understood by reassessing environmental performance to date and identifying areas where changes are needed.

Socioeconomic Factors Impeding Good Environmental Management

Nepal's poor record on the environment stems from the fact that Nepal is a country in transition with a poor economy and is confronted by many other major challenges of infrastructure development. The continuing political instability and security problems are adversely impacting both the economy and the environment. Frequent changes in governments, the lack of a parliament for prolonged periods, and the present conflict situation have all contributed to undermining organizational capacity, and outreach and monitoring at all levels. These have severely undermined progress in environmental management. Poverty is forcing poor people to indiscriminately use and overexploit natural resources for daily survival.

Although the Government maintains that promoting environmental activities is a high priority, budgetary allocations remain grossly inadequate, and provisions for obliging communities to sustainably manage environmental resources remain lacking. Inadequate advocacy and awareness of the importance of protecting and managing the environment are prevalent. Lack of awareness in urban areas has resulted in increased pollution from the misuse and abuse of resources and environmental mismanagement, while lack of awareness in rural areas has resulted in unsustainable use of natural resources.

Under-funded Environment and Natural Resource Mandates

Public sector institutions such as ministries, departments, and corporate bodies are short of technically skilled human resources specialized in the various environmental fields. Lack of the funds needed to execute their mandates means that the databases, research facilities, and laboratories needed for environmental monitoring are lacking (see Chapter 10). This situation has made environmental institutions dependent on external facilities. For example, MOPE, even after 9 years of existence, did not have a laboratory of its own for emission testing of vehicles and depended on the facilities available with the traffic police office. Local government bodies at the district and village levels also need technical staff, facilities, and funding, without which they cannot execute their mandated environmental activities as promoted by the Local Self Governance Act 1999. The same situation with respect to instrumentation and staff prevails among NGOs and the private sector. Lack of logistical support has prevented agencies concerned from making field trips to project sites to carry out environmental surveillance and monitoring activities.

Well-trained technical staff are in short supply and while two universities (and a number of colleges) have taken up the challenge of training environmental experts and giving environmental training to students in related disciplines, they need to be more actively encouraged and supported. Environmental departments need to make costly investments in instrumentation for hands-on training, and this also needs to be reviewed. To date it has been difficult to attract young people to environmental disciplines since it is known that environmental staff are poorly remunerated. The morale of graduate-level environmental staff is low. Because they are not categorized as an "environment group" by government administrative rules, they are deployed under miscellaneous groups, which not only negatively impacts their careers but also discourages new recruits.

Conflicting and Overlapping Mandates

Conflicts and problems related to overlapping mandates appear in many areas but are especially prevalent between institutions with long histories and those that are relatively new. There is a strong need to review all existing sectoral environmental legislation and harmonize it. Here we cite examples that can arise between different agencies and ministries to show how pervasive the problems are.

Conflicts arise, for example, in cases which involve forested areas. As per the provisions of the Environment Protection Act and Regulations, MOEST is authorized to approve EIA reports on development projects (like transmission lines and hydropower plants). Nevertheless, the Forest Act 1993 says that in cases where such projects involve forested areas, MOFSC also has the right to review and reject them. Lack of expertise and facilities means that the approval process by MOFSC may take a long time, and often these delays compromise project viability. Experiences of program implementation reveal that while awaiting an environmental decision, developers often take matters into their own hands and clear extra forests and inflict other damage. Legislation and human resources to monitor or prosecute this behavior are weak or lacking, and in the process projects of possibly national importance are jeopardized.

Similarly, the National Parks and Wildlife Conservation Act 1973, amended 1993, prohibits any outside interference in projects undertaken in protected areas. While MOFSC cannot overrule the

park management, this legislation nevertheless conflicts with MOFSC's mandate to oversee all forest administration. Similarly, if in trying to fulfill its mandate as the overseer of all forests MOFSC undertakes projects in forested protected areas, these can be vetoed by park authorities. Other conflicts over forested areas arise from the fact that under Environment Protection Act rules, MOEST can declare certain forested areas to be conservation areas. MOFSC has the same mandate under the Forestry Act. While the discussions over jurisdiction continue, important forest areas continue to degrade, as do watersheds, wetlands, and river basins.

Agriculture-based private industries registered with the Ministry of Industry, Commerce and Supplies can sell imported products such as fertilizers and pesticides to farmers. When these products are of low quality, they can wreak havoc on agricultural production, the soil, the environment, and people's health. Since these industries are not registered with the Ministry of Agriculture and Cooperatives and one ministry cannot interfere with the jurisdictions of another, the Ministry of Agriculture and Cooperatives cannot prosecute their wrongdoing. In this turf war, the farmer ultimately loses. Yet another area of conflict arises because ministries have an obligation to monitor projects implemented under their jurisdiction; however, MOEST can also intervene to monitor them under the Environment Protection Act and Regulations. This creates confusion and conflicts between MOEST and the ministries concerned.

These examples illustrate the need for harmonization. In this process the advisory and policy making public sector bodies should coordinate efforts in consultation with the private sector organizations, corporate bodies, and local bodies.

Lack of Consolidated and Participatory Actions

Although government policies and plans commonly advocate the need for greater participation between the public sector, its central and local bodies, local NGOs, communities, and users' groups, it is difficult to see sufficient progress in this direction. While it is commonly acknowledged that the participation of all of these groups is a prerequisite to securing holistic support, timely delivery, and continued implementation of almost any environmental program, this advice remains largely unheeded; moreover, the will to secure this common participation needs prompting.

To date there are a few concrete vehicles for active community feedback. One such is the EIA process. Public hearings and consultations at project sites are required several times as part of the EIA process. These consultations take place with different public and private agencies, NGOs, and the media. Major projects on hydropower development such as the Kali-Gandaki A project, the Pancheswor High Dam Project, Upper Karnali Hydro Project, and Middle Marshyangdi Hydro Project; some large irrigation projects like the Mahakali irrigation, the Sunsari Morang irrigation, and the Narayani Irrigation; and the Melamchi Water Supply projects have been widely discussed. The local communities, media, donors, and major stakeholders all participated; however, there is still room for improvement which would involve standardizing the process and ensuring that it is conducted more frequently.

Public consultations also take place in projects that involve community water supplies, farmer managed irrigation systems, and others. Here citizens' groups are actively encouraged to give feedback through public hearings. There is also regular coverage in the media on major environmental issues, mostly related to different types of pollution. Many environmental NGOs like the Martin Chautari Society, the Society of Environmental Journalists, and others have been voicing environmental concerns in different seminars and through FM radio and television channels.

Experiences of MOFSC and Nepal Water Supply and Sewerage Department indicate that projects that have active community participation like the community forestry programs and water supply schemes in rural areas often have better success rates. Efforts should be made to foster this participation by encouraging greater interaction among the project teams, contractors, consultants, communities, and local social groups on environmental projects, especially by promoting the involvement of Nepali environmental experts as consultants, advisors, and monitors, and by involving Nepali field-based NGOs.

Difficulties in Utilizing Donor Support

As government allocations are admittedly marginal, environment management in Nepal has been essentially donor-driven, and this situation has occasionally led to difficulties. It is often felt that donors could spend more time interacting with the Government to better understand Nepal's development needs, since it is always useful to harmonize government priorities and donor concerns, terms, and conditions. Donors often apply common models for all developing member countries when formulating their programs, whereas local socioeconomic and environmental conditions

can vary considerably. Both sides have recognized that more face-to-face interactions between the Government and donors are needed. The Nepal Development Forum, a group of different development partners of Nepal, has been addressing this need. Another common complaint is that the Government's lack of coordinating capability has often led to duplication in selection and implementation of projects. The Nepal Aid Group is helping donors to sort these issues out among themselves to enhance effectiveness of their assistance to Nepal.

Another common difficulty is that Nepal can often not accept all of the needed aid in a given sector because it does not have enough absorptive capacity to utilize all the available assistance from the donors. Often, significantly more capacity must be built before sophisticated or wide-ranging projects on the environment can be undertaken.

There are also occasional differences of opinion on the conditions set by different donors for providing loans, as their requirements, terms, and conditions often differ from each other. A common disappointment is that donors tend to select and approve consultants unilaterally, only completing the formalities of consultation with the client country just before signing the agreement. Given that payments to foreign consultants often take a significant amount of the loan, the frustration is understandable.

Institutional Strengthening and Capacity Building

After the establishment of MOPE (now MOEST) in 1995, a substantial number of environmental laws and regulations were developed. About half of the prevailing environmental laws now in force in Nepal date from 1992. Widespread public concern over pollution led to legislation to curb emission of effluents and airborne pollutants, while concern over the depletion of natural resources led to legislation for preserving conservation areas such as national parks and wildlife areas with special biodiversity value. While the laws exist in principle, institutional weaknesses continue to prevent the effective monitoring and implementation of these laws.

Institutions at all levels are weak, including the NPC, line ministries, local governments, and VDCs. Requisite technical skills are commonly lacking, and poor morale is a systemic issue. These deficiencies stem from the general weakness of the public administration system itself—over-staffing, low salaries, political interference in appointments and transfers, and inadequate performance recognition. These in turn affect public resource management. The capacity to monitor the implementation of laws and public expenditures is weak at all levels. Inadequate supervision, poor financial management, dilatory government procedures, and lack of coordination among government entities are some other indicators, all of which lead to poor performance generally and to a serious neglect of environmental issues in particular.

Nepal needs to build up its capacity for national and regional development so that it can effectively participate in the global economy. There is a need to strengthen the public and private sectors, institutions, systems, processes, procedures, and practices that support development efforts. Improved capacity is needed to entrench and sustain good governance, design and manage effective policies and programs, manage the environment, address poverty, and apply science and technology to development problems. Capacity is also needed to accelerate regional development and for Nepal to participate with other regions as an effective partner in the global economy.

Improvements in the Legislative System

A large number of environmental acts and regulations have been promulgated in Nepal during the last 10–15 years to facilitate the implementation of environmental plans and programs, but these have had only limited success. This legislation now needs to be updated and amended to make it responsive to the present requirements of complex environmental concerns[3] and rigorously enforced.

In addition, new regulations are needed to help Nepal take full advantage of World Trade Organization membership, which Nepal recently entered, becoming the 147th member. The main aim of membership is to improve Nepal's economy by opening up trade with the entire world. Policymakers and businessmen need to be aware of how to make the most of these opportunities and how not to be overcome by an open trading regime. One commitment made by Nepal was to amend the Environment Protection Act 1996 to complement the requirements related to trade and the environment. Nepal also needs to include provisions for developing additional environmental standards for protection of human and plant life. Amendments to existing legal provisions for capacity building of environmental cells in the Federation of Nepalese Chambers of Commerce and Industries and other major associations of commerce and industries will be required. Industries should be motivated to adopt

[3] For example there is no provision in the Environment Protection Act and Regulations for control and management of hazardous waste from hospitals and nursing homes; and there are no guidelines on control of effluents being discharged by industries. Some other regulations related to the protection of the environment, conservation of biodiversity, and sustainable use of non-timber forest products also need amendments to prevent over-collection and illegal trade.

and comply with International Standards Organization (ISO) standards and eco-labeling of industrial products.

While it is clear that the existing environmental laws and regulations need to be reviewed, they also need to be enforced. Nepal's poor performance in the environmental sector has largely been a failure to fully empower regulatory bodies to enforce regulations, monitor compliance, and impose penalties. The environmental commitment of institutions nominally responsible for enforcement, such as NPC and MOEST, is weak and the enforcement piecemeal—there is a lack of enforcement modalities and a lack of coordination among the different agencies.

A strong institutional base is needed to monitor and back up the legal instruments applied to environmental conservation. In many cases law enforcement is thwarted due to poor institutional infrastructure, lack of institutional decentralization, or the constant shifting of responsibilities from one institution to another resulting in no one institution taking up the task at hand. A strong, transparent, and effective monitoring system that can support proper enforcement of laws and regulations is needed.

For example, to comply with international treaties, a list of rare and endangered species has been prepared by MOFSC. However, whether the aforementioned species are still endangered or rare is never scientifically monitored. Surveillance of legal instruments both internationally and nationally is lacking. Creating a repository of all the relevant environmental information in the country and making it accessible to all stakeholders through electronic means would help to make the system more transparent and easier to enforce.

Strengthening the EIA/SEA Framework

An effective monitoring and evaluation mechanism to review compliance with existing environmental laws is also needed. Under the provisions of the Environment Protection Act and Regulations, it is mandatory to assess the technical, industrial, and socioeconomic impacts of development projects on the environment and on the population. The agency concerned needs to approve the requisite EIA reports before any project is started. Projects without significant environmental impacts only need an IEE to be conducted by relevant agencies. The NPC has adopted and applied the concept of SEA for project development policies and programs included in the Tenth Five-Year Plan (2002–2007). While the EIA assesses environmental impacts of development projects at the project level, the SEA assesses environmental impacts of development projects at the planning, policy, and programming stages and can be used in evaluating strategic proposals for appropriate decision making.

EIA and SEA capacity issues are acute. The EIA is still largely considered an "add-on" project burden, and EIA reports are commonly based on inadequate data. Although MOEST has already approved 25 EIA reports from different projects, it has not been able to monitor the proposed mitigation of identified impacts. Recent experience based on a cross-section of development projects shows that the EIA process is usually enforced as part of the initial approval process during approval of EIA reports by MOEST. However the problems come later at the implementation stage when actual site conditions differ from initial preliminary assessments.

From this perspective, capacity development in augmenting, mobilizing, and enhancing the EIA and SEA capability of a country, organization, professional body, or group of individuals is much needed for strengthening this sector. The knowledge, tools, and skills necessary to operate an EIA or SEA system to an acceptable level of performance have to be developed. The scope of capacity development can range from establishing preconditions for EIA or SEA development to benchmarking good practice. Supporting measures include research, policy analysis, institutional design, information exchange, training and skills transfer, building networks, professional development, and guidance on implementation of good practices.

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Appendix 9.1: Environmental Standards Developed by Different Public Sector Agencies in Nepal

Standards related to air quality are presented in Chapter 7, Appendix 7.1.

Table A9.1.1: Generic Standards: Tolerance Limits for Industrial (Wastewater) Effluents Discharged into Inland Surface Waters and Public Sewers

Serial Number	Parameter	Tolerance Limit		
		Industrial Waste into Inland Surface Waters	Wastewater into Inland Surface Waters from CWTP [a]	Industrial Effluents into Public Sewers [b]
1	TSS, mg/l	30–200	50	600
2	Particle size of TSS	Shall pass 850-micron sieve	Shall pass 850-micron sieve	
3	pH Value	5.5–9.0	5.5–9.0	5.5–9.0
4	Temperature $^{0}C^{c}$	< 40	< 40	<45
5	TDS, mg/l, max			2,100
6	Color and odor			
7	BOD for 5 days at 20 °C, mg/l, max	30–100	50	400
8	Oils and grease, mg/l, max	10	10	50
9	Phenolic compounds, mg/l, max	1.0	1.0	10
10	Cyanides (as CN), mg/l, max	0.2	0.2	2
11	Sulfides (as S), mg/l, max sulfates (SO_4), mg/l, max	2.0	2.0	2.0 500
12	Radioactive materials: Alpha emitters, c/ml, max Beta emitters, c/ml, max	 10^{-7} 10^{-8}	 10^{-7} 10^{-8}	
13	Insecticides	Absent	Absent	Absent
14	Total residual chlorine, mg/l	1	1	1,000 as chlorides
15	Fluorides (as F), mg/l, max	2.0	2.0	10
16	Arsenic (as As), mg/l, max	0.2	0.2	1.0
17	Cadmium (as, Cd), mg/l, max	2.0	2.0	2.0
18	Hexavalent chromium (as Cr), mg/l, max	0.1	0.1	2.0
19	Copper (as Cu), mg/l, max	3.0	3.0	3.0
20	Lead (as Pb), mg/l, max	0.1	0.1	0.1
21	Mercury (as Hg), mg/l, max	0.01	0.01	0.01
22	Nickel (as Ni), mg/l, max	3.0	3.0	3.0
23	Selenium (as Se), mg/l, max	0.05	0.05	0.05
24	Zinc (as Zn), mg/l, max	5	5	5
25	Sodium, %, max.			
26	Ammonical nitrogen, mg/l, max	50	50	50
27	COD, mg/l, max	250	250	1,000
28	Silver, mg/l, max	0.1	0.1	0.1
29	Mineral oils, mg/l, max			10
30	Inhibition of nitrification test at 200ml/l			< 50%

°C = degrees Celsius, c/ml = count per milliliter, max = maximum, mg/l = milligram per liter, ml/l = milliliter per liter, BOD = biological oxygen demand, COD = chemical oxygen demand, CWTP = combined wastewater treatment plant, TDS = total dissolved solids, TSS = total suspended solids

[a] Under enforcement since B.S. 2058/1/17 (30 April 2001) .

[b] Under enforcement since B.S. 2060/3/ 9 (23 June 2003) .

[c] Shall not exceed 40 ^{0} C in any section within 15 m downstream from the effluent outlet.

Source: MOPE (2003)

Table A9.1.2: Industry-Specific Tolerance Limits for Industrial Effluents Discharged into Inland Surface Waters [a]

Serial Number	Parameters	Generic	Leather	Wool Processing	Fermentation	Vegetable Ghee and Oil	Paper and Pulp
1	TSS, mg/l	30–200	100	100			
2	Particle size of TSS	Shall pass 850-micron sieve			100		100
3	pH Value	5.5–9.0	6.0–9.0	5.5–9.0	5.5–9.0	6–9	5.5–9
4	Temperature ^0C[b]	< 40		40			
5	TDS, mg/L, max		2100				
6	Color and odor		Absent[c]				
7	BOD for 5 days at 20 °C, mg/l	30–100	100	100	60	100	100
8	Oils and grease, mg/ l, max	10		10		10	
9	Phenolic compounds, mg/l, max	1.0		5 (as C_6H_5OH)			
10	Cyanides (as CN), mg/ l, max	0.2					
11	Sulfides (as S), mg/ l, max	2.0	2.0	2.0			
12	Insecticides	Absent					
13	Total residual chlorine, mg/l	1	600 max.				
14	Hexavalent chromium (as Cr), mg/l, max	0.1	0.1 Total 2.0	Total 2.0			
15	Nickel (as Ni), mg/ l, max	3.0		250			3
16	Sodium, %, max		60				
17	COD, mg/l, max	250	250				250

°C = degrees Celsius, max = maximum, mg/l = milligram per liter, BOD = biological oxygen demand , COD = chemical oxygen demand , TDS = total dissolved solids, TSS = total suspended solids

[a]Under enforcement since B.S. 2058/1/17 (30 April 2001) .

[b] Shall not exceed 40 ^{0} C in any section within 15 m downstream from the effluent outlet.

[c] No standards for color .

Source: MOPE (2003)

Table A9.1.3: Industry-specific Tolerance Limits for Industrial Effluents Discharged into Inland Surface Waters [a]

Serial Number	Parameters	Dairy	Sugar	Cotton Textile	Soap
1	pH	5.5–8.5	5.5–8.5	6.0–9.0	6.0–9.0
2	TSS mg/l, max	150	100	150	200
3	BOD (5 days at 20 °C) mg/l, max	100	100	100	100
4	Oil and Grease, mg/l , max	10			10
5	COD, mg/l, max	250	250	250	250
6	Phenolic compounds mg/l, max				1

°C = degrees Celsius, max = maximum, mg/l = milligram per liter, BOD = biological oxygen demand , COD = chemical oxygen demand , TSS = total suspended solids

[a] Under enforcement since B.S. 2060/3/9 (23 June 2003).

Source: MOPE (2003)

Appendix 9.2 Some Major Environment-related International Conventions Participated in by Nepal

Conventions Related to

a. Natural Resource Management

1. **Plant Protection Agreement for the South East Asia and the Pacific Region**
   Date of entry into force in Nepal: 12 August 1965
   Major Objectives: To prevent introduction and spread of destructive plant diseases and pests
   Major Obligations: Regulate trade in plants and plant products

2. **Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES)**
   Date of entry into force in Nepal: 16 September 1975
   Major Objectives: To protect and regulate the trade of wild fauna and flora and their products
   Major Obligations: All species threatened with extinction should be legally protected with appropriate measures and trade regulated

3. **Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention)**
   Date of entry into force in Nepal: 17 April 1988. At the beginning Koshi Tappu included in the Ramsar List; Bishajariya Tal in Chitwan, Ghodaghodi Tal in Kailali, and Jagadishpur Reservoir in Kapilvastu districts included in the Ramsar List by the Ramsar Bureau on 17 September 2003
   Major Objectives: To prevent the loss of wetlands
   Major Obligations: Parties should designate at least one national wetland and ensure conservation and sustainable use of migratory stocks of wildfowl

4. **International Tropical Timber Agreement**
   Date of Ratification or Accession: 3 July 1990
   Major Objectives: To ensure conservation and sustainable use of timber and enhance international timber trade
   Major Obligations: To implement activities for forest management and any decisions on timber trade

5. **Agreement on the Network of Aquaculture Centers in Asia and the Pacific**
   Date of Ratification or Accession: 4 January 1990
   Major Objectives: To develop aquaculture for increasing production, improving rural income and employment, and increasing foreign exchange earnings
   Major Obligations: To expand network of aquaculture centers, strengthen institutional capacity, and promote exchange of information

6. **Convention on Biological Diversity (CBD)**
   Date of entry into force in Nepal: 21 February 1994
   Major Objectives: To ensure conservation, sustainable use, and equitable sharing of benefits of biological diversity
   Major Obligations: To prepare and implement national strategies, plans, and programs, including a national biodiversity action plan, for the conservation of biodiversity under both in situ and ex situ conditions. Nepal Biodiversity Strategy approved by the Government of Nepal in August 2002

7. U**N Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa**
   Date of entry into force in Nepal: 13 January 1997
   Major Objectives: To combat desertification and mitigate the effects of drought through effective actions at all levels
   Major Obligations: To prepare and implement National Action Programmes, and to integrate strategies for poverty reduction; National Action Programme approved by the Government of Nepal on 2 February 2004

b. Cultural Heritage

8. **Convention for the Protection of the World Cultural and Natural Heritage**
   Date of entry into force in Nepal: 20 September 1978
   Major Objectives: To protect cultural and natural heritage of universal value
   Major Obligations: To ensure implementation of effective measures for the protection, conservation and preservation of national cultural and natural heritage

c. Nuclear Weapons

9. **Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water**
   Date of Ratification or Accession: 7 October 1964
   Major Objectives: To put an end to the armaments race and eliminate incentives to the production and testing of all kinds of weapons
   Major Obligations: To prohibit, prevent any nuclear weapon test at any place

10. **Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space Including the Moon and Other Celestial Bodies**
    Date of entry into force in Nepal: 10 October 1967
    Major Objectives: To establish an international legal regime for the exploration and use of outer space
    Major Obligations: To prohibit placing objects carrying nuclear weapons or other weapons of mass destruction in outer space and avoid harmful contamination of outer space

11. **Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Sea-bed and the Ocean Floor and in the Subsoil Thereof**
    Date of entry into force in Nepal: 18 May 1972
    Major Objectives: To reduce the arms race and international tensions, and to maintain world peace
    Major Obligations: To prohibit placement of any weapons of mass destruction on the sea bed, ocean floor or in the subsoil thereof, and observe and verify the activities of other parties on the sea bed

d. Marine Environment

12. **Convention on the High Seas**
    Date of entry into force in Nepal: 27 January 1963
    Major Objectives: To codify the rules of international law relating to the high seas
    Major Obligations: To take measures to prevent pollution of the sea by any activity

e. Waste Management

13. **Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter**
    Date of Ratification or Accession : 1 January 1973
    Major Objectives: To control pollution of the sea
    Major Obligations: To prohibit dumping or deliberate disposal of wastes in the sea

14. **Basel Convention on the Control of Transboundary Movements of Hazardous Wastes (Basel Convention)**
    Date of entry into force in Nepal: 13 January 1997
    Major Objectives: To regulate the transboundary movements of hazardous waste
    Major Obligations: To define hazardous waste, and prohibit and/or regulate the movements of such waste

f. Ozone Layer Protection

15.a **Vienna Convention for the Protection of the Ozone Layer (Vienna Convention)**
    Date of entry into force in Nepal: 4 October 1994
    Major Objectives: To protect human health and the environment against adverse effects of the modification of ozone layer
    Major Obligations: Limit and/or eliminate the use of ozone-layer depleting substances

15.b **Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol)**
Date of entry into force in Nepal: 4 October 1994
Major Objectives: To protect the ozone layer by controlling the emissions of substances that deplete it
Major Obligations: To control annual consumption and production of substances that deplete the ozone layer

15.c **London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (London Amendment)**
Date of entry into force in Nepal: 4 October 1994
Major Objectives: To strengthen the control procedures and to establish financial mechanisms for the protocol
Major Obligations: To amend the protocol to phase out the production of some of the substances that deplete the ozone layer, and to establish financial mechanisms and a clearing-house function for the implementation of the protocol

g. Climate Change

16. **United Nations Framework Convention on Climate Change (UNFCC)**
Date of entry into force in Nepal : 31 July 1994
Major Objectives: To stabilize greenhouse gas concentrations in the atmosphere within a time frame
Major Obligations: Adopt precautionary measures to minimize or prevent the release of greenhouse gases and mitigate the effects of climate change

Conventions Only Signed

17. **Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxic Weapons and on their Destruction**
Date of Adoption: 10 April 1972
Date of Nepal's signature: 10 April 1972
Major Objectives: To prohibit the development of biological weapons and eliminate them
Major Obligations: To prohibit development, production, stockpiling, or acquisition or retention of any biological weapons, and promote their destruction

18. **UN Convention on the Law of the Sea**
Date of Adoption: 10 December 1982
Date of Nepal's signature: 10 December 1982
Major Objectives: To develop a comprehensive new legal regime for the sea with environmental provisions
Major Obligations: To define territorial sea and exclusive economic zones, and to develop sea resources for human beings

19. **Convention on Fishing and Conservation of the Living Resources of the High Seas**
Date of Adoption: 29 April 1958
Date of Nepal's signature: 29 April 1958
Major Objectives: To conserve the living resources of the sea
Major Obligations: To adopt necessary measures for the conservation of the living resources of the high seas, and supply of food for human consumption

20. **Convention on the Continental Shelf**
Date of Adoption: 29 April 1958
Date of Nepal's signature: 29 April 1958
Major Objectives: To delimit the rights of states to explore and exploit the natural resources of the continental shelf
Major Obligations: To regulate the interference with navigation, fishing or the conservation of the living resources of the sea by the exploration or exploitation activities of coastal states

21. **Stockholm Convention on Persistent Organic Pollutants (POPs)**
Date of Nepal's signature: 5 April 2002
Major Objectives: to eliminate or restrict production and use of Persistent organic pollutants including pesticides and industrial chemicals as well as to restrict their trade with the final goal of banning production, trade and use of POPs
Major Obligations: Signatory countries are obliged to support and comply with the provisions of UNEP's policy of phasing persistent organic pollutants out or limiting their production and use.

Appendix 9.3: Some Prominent Environmental NGOs in Nepal

(i) Association for Protection of Environment and Culture (APEC-NEPAL), established in 1988, applies a multidisciplinary approach to protection of wildlife, forests, and wetlands, and to management of renewable resources. Numerous programs are described.

(ii) Clean Energy Nepal (CEN) promotes conservation and sustainable energy use, especially in Kathmandu Valley, through campaigns and public education. It has a newsletter and publications.

(iii) Concern for Children and Environment — Nepal (CONCERN), established in 1993, works in child development.

(iv) Discover Nepal, established in 1998, places trained volunteers in rural and urban secondary schools, as well as in environmental, health, and tourism programs.

(v) Institute for Himalayan Conservation — Nepal (IHC-Nepal) continues programs initiated by IHC-Japan, which created the Multi-dimensional Annapurna Conservation (MAC) Project in Mustang and Myagdi. These programs focus on forestry management, environmental education, use of appropriate technologies, health awareness, ecotourism, and local capacity building.

(vi) International Institute for Human Rights, Environment and Development (INHURED International), since 1987, monitors violations of human and environmental rights. In 1993 it won a major campaign on the Arun III Hydroelectric Project. It has publications, audio and video cassettes, and articles.

(vii) IUCN Nepal, since 1973, works to protect environmentally sensitive areas and wildlife species through numerous projects. Many publications are available. It is in the World Conservation Union (IUCN).

(viii) King Mahendra Trust for Nature Conservation (KMTNC) works broadly to protect and conserve the natural and cultural heritage of Nepal.

(ix) Nepal Forum of Environmental Journalists (NEFEJ), begun in 1986, promotes the participation of mass media in raising public awareness about the environment and sustainable development.

(x) Nepal River Conservation Trust (NRCT), established in 1995, works towards conserving Nepal's Himalayan river system, preserving cultural heritage, and developing an environmentally responsible river tourism industry.

(xi) Rhododendron Research Project, sponsored by the Norwegian Research Council, aims to identify climatic limits for rhododendrons found in Nepal, with the long-term aim of stimulating local economies and helping with reforestation.

(xii) South Asian Network for Development and Environmental Economics (SANDEE), started in Kathmandu, addresses environmental and developmental challenges for participating South Asia countries.

(xiii) The Mountain Institute (TMI) operates projects to protect the biodiversity and cultural heritage in the Himalayas.

(xiv) World Wide Fund for Nature (WWF) Nepal Programme, working in Nepal since 1967, has numerous conservation projects and programs.

(xv) SEEDS (Social Educational Environmental Development Services), since 1998, funds a wide range of grass-roots development and relief projects in remote rural areas.

(xvi) Alliance for Environmental Protection, Nepal (AEPN), provides consultancy services for matters related to environmental management and protection.

(xvii) Environment and Public Health Organization Nepal (ENPHO), conducts water and air quality analysis and provides laboratory services for the same.

Chapter 10

Environmental Financing

Introduction

Environmental financing is a new area of concern in Nepal. Once the benefits of conserving the environment are understood, budgetary allocations for national and local environmental programs will increase. At present environmental financing takes place in national and local budget allocations. Nepal has realized the importance of conserving environmental and natural resources through policies, legal measures, and institutional development. Institutions such as the Ministry of Environment, Science, and Technology (MOEST); and the ministries of Forests and Soil Conservation, Water Resources, Agriculture and Cooperatives, and Industry play major roles in environmental programs and therefore in environmental financing.

Based on the State of the Environment report (UNEP 2001), Nepal has identified 17 environmental issues of national significance, classified as most urgent, moderately urgent, and less urgent but significant. The most urgent environmental issues are: land degradation, forest depletion, solid waste, water pollution, and air pollution. The first two issues pertain to rural areas, where over 80% of the population lives; the latter three are outcomes of haphazard urban development and inadequate consideration of environmental aspects during urbanization and industrialization.

Moderately urgent environmental issues identified include: dwindling biodiversity, desertification, noise pollution, forest fires, groundwater pollution, glacial lake outburst flood events, food security, and alternative energy. Of these, biodiversity and desertification also have long-term implications for food security. Groundwater depletion, particularly in Kathmandu Valley, has been a major concern. Other environmental problems that are less urgent in terms of the need for implementation but still significant include loss of aquatic fish, haphazard urbanization, depletion of biomass energy, and transboundary movement of wastes.

Environmental financing is required in managing forests and land resources, and in minimizing water and air pollution. In rural areas, most of the funds are required for the conservation, management, and sustainable use of the natural resource base, particularly forest, soil, and water conservation, water harvesting, and mineral resources. As most of the people depend upon agriculture, financing is necessary for promotion and expansion of sustainable agricultural systems to reduce poverty and to ensure food security. Ultimately, this will reduce loss of fertile topsoil and promote water retention. In urban areas, environmental financing is urgently required for the improvement of water and air quality, solid waste management, and reducing noise levels.

Domestic Sources

A number of domestic sources could generate the needed funds. Some of the potential areas are the sustainable use of water resources, and mining of precious metals, forests, and wildlife. There are vast potentials for hydroelectricity generation, development of irrigation schemes, and promotion of navigation and recreational sports. Deposits of precious metals can be explored and utilized in an environmentally friendly way. In the forestry sector, there is a vast potential for sustainable utilization of non-timber forest products (NTFPs) such as leaf, bark, fruits, and roots. Commercially valued plant species could also be planted and harvested on barren or public or private land as income generation activities. Some of the nurseries developed for promotion of NTFPs have shown potential for development and promotion. The public and private sector have been developing such nurseries in different parts of the country. A nursery developed and maintained by the Rural Development Service Center in Doti district can be taken as an example. Protected areas are an emerging sector where eco-tourism could be promoted. Some of the common wild animals could also be utilized and/or domesticated and marketed. These funds could be recycled for environmental and natural resource conservation. The above activities are envisaged to be undertaken by public-private participation with support from donors as needed.

Some funding arrangements made by the government for natural resource management are summarized below.

National Level Funding

The Ministry of Finance disburses funds on the basis of the approved annual budget. Reviewing the development outlay from 1985 to 2002, there is an increasing trend towards funding sectors like agriculture, forestry, water resources, mining, and local development. About 14% of the total budget has been allocated to these sectors for the Tenth Plan (2002–2007) period. The budget outlay is several times more in the water resources, electricity, and irrigation sectors than the environment in general and forest management in particular.

About NRs 11 million were allocated to the environment sector from 1985 to 1990. For the Tenth Plan period, about NRs 111 million have been allocated for environmental activities in the country, about 0.05% of the total proposed development outlays of NRs 234,030 million (Figure 10.1).

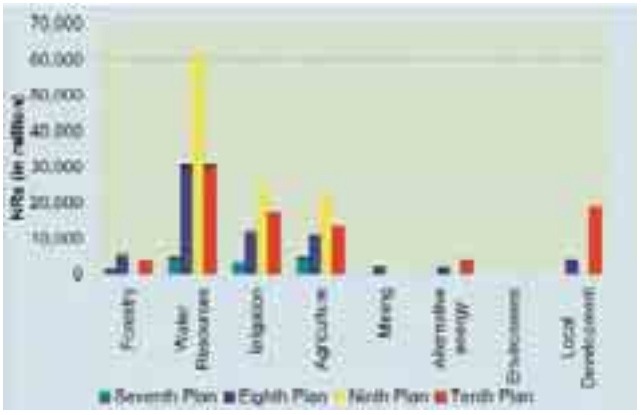
The Tenth Plan identified a number of environmental activities and prioritized them. The first priority programs included pollution control and prevention, environmental impact assessment, and environmental awareness raising. The second priority projects included urban parks, land use planning, environmental standards, and monitoring. MOEST is responsible for implementing these programs.

Similar funds have been allocated for the conservation, development, and management of forests and protected areas. Next to forest related activities, land and watershed degradation is of major concern in the sustainable management of natural resources. These activities receive comparatively larger budgetary allocation.

The development budget allocations for the forestry sector indicate higher Government funding than grants from bilateral and multilateral agencies (Figure 10.2). The Government's policy has been to discourage taking loans in the forestry sector and to increase recycling of the funds generated through management of protected areas and through the sustainable use of forest resources. Nevertheless, foreign assistance in the form of grants has increased from FY2001 onwards. The Department of Forest, which has a countrywide institutional network, receives funds both from the Government and from donors to carry out various forestry activities (Figure 10.3). In the mean time the funds required for management of protected areas come from the national consolidated fund.

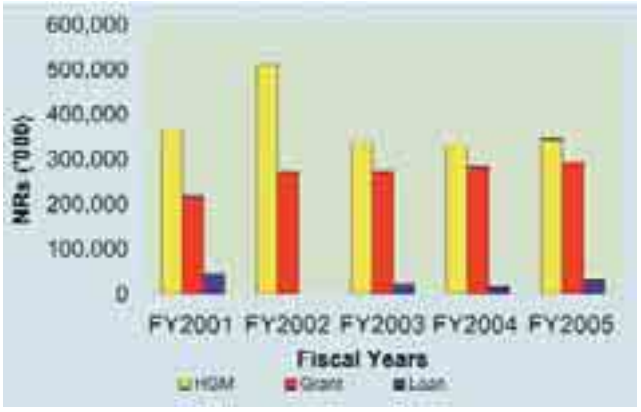
Budget allocations for plant resources management, and forest survey and research are very low, indicating inadequate attention to these

Figure 10.1: Development Outlay in Major Sectors (1985–2007)



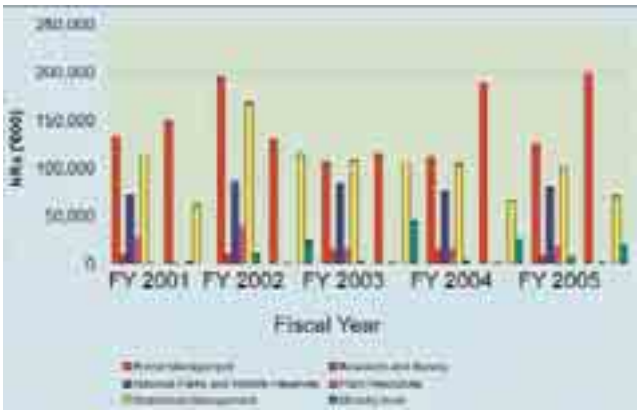
Source: 7th–10th Five Year Plan documents

Figure 10.2 Program Cost in the Natural Resource Management Sector



Source: Ministry of Forest and Soil Conservation records

Figure 10.3: Budget Allocation for Different Programs in the Forestry Sector



Source: Ministry of Forest and Soil Conservation records

areas. Similarly, the Department of Plant Resources which implements activities related to plant exploration, ex-situ conservation of plant diversity, and phyto-chemical research, has low funding. Two Government companies, Royal Drugs Limited and Herbs Processing and Production Center Limited, were established to produce medicines from plants and herbs. All phyto-chemical and bio-technological research activities for their establishment were conducted by the Department of Plant Resources.

Other ministries such as Agriculture, Water Resources, Physical Planning and Works, and Transport, and the municipalities also have funds available for environment-related activities. These include funds for sector-specific environmental impact assessment activities, some environmentally friendly measures (such as organic agriculture and roadside planting), and solid waste management. The funds committed by the Government for these activities are channeled to the research agencies concerned through related government departments. These agencies usually have difficulties in receiving allocated funds on time.

Environment Conservation Fund

The Government of Nepal established the Environment Conservation Fund under the Environment Protection Council in 1993 to finance environmental activities. Section 13 of the Environment Protection Act 1996 has provisions to establish a fund for protection of the environment, control of pollution, and protection of National Heritage sites. Funds received from the Government of Nepal, foreign governments or international organizations, and other sources are deposited in this fund, which is audited by the Auditor General of Nepal.

In order to administer this fund, the Environment Protection Regulations 1997 also provide for a Managing Committee under the chairmanship of the Secretary of the Ministry of Environment, Science and Technology. The committee has representatives from the National Planning Commission Secretariat, Ministry of Finance, Nepal Rastra Bank (Central Bank), Federation of Nepalese Chambers of Commerce and Industries, and an environmental expert or chief of an environment-related nongovernment organization (NGO).

Over the years, about NRs 40 million has been deposited in this fund. So far, no donor agencies or private sector groups have supported this fund. The fund was used in 1997 and 1998 by 15–20 local environmental NGOs from different districts of the country for implementing environment conservation and pollution control activities. However, due to the unsatisfactory performance of these NGOs, further allocation of funds was abandoned.

Poverty Alleviation Fund

The Government of Nepal established the Poverty Alleviation Fund (NPC 2003) in 2004 with support from the World Bank; it will remain effective until 2009. The main objective of the fund is to support Nepal to reduce poverty by improving the access to income generation projects and community infrastructure for marginalized groups, including environmental management.

The Poverty Alleviation Fund has also focused on environmental management to improve the livelihoods of the poor and conserve the environment. It seeks to reduce poverty by (i) preventing or mitigating negative environmental impacts that may emerge from sub-projects, (ii) ensuring the long-term sustainability of benefits from sub-projects by securing the natural resources base on which they depend, and (iii) facilitating projects that increase sustainable use and improvements in local environmental quality and human well-being.

The Fund finances demand-driven projects under several broad categories: income generation, infrastructure, and innovative and special programs. The fund was to be provided in the areas of livestock development, minor irrigation, agricultural development, forest products, infrastructure development, and micro enterprises. These projects should meet the criteria of productivity, equity, and sustainability. The fund has also focused on developing "environmental codes of practice" consonant with World Bank guidelines. The Codes of Practice include environmental compliance requirements and best practice guidelines for mitigation of environmental impacts.

National Agricultural Research and Development Fund

The Government of Nepal established the National Agricultural Research and Development Fund in December 2001 in accordance with the provision of the Working Fund Act, 1986 (B.S. 2043) to provide funding for action research in the agriculture sector.

The fund will be allocated for research and development in five areas: productivity of the farming system, crop research and extension, livestock and fisheries research and extension, sustainable utilization of natural resources and protection of the resource base and the environment, and NTFPs and crops in the Hills.

The budget for the fiscal year 2005 is NRs 70 million from the Hill Agriculture Research Project, which is funded by the UK Department for International Development (DFID), and the Crop Diversification Project. The Fund has provided a total of NRs 24 million for the development of 15 projects

(NARDF 2004) for a period of 1 to 3 years starting from 2003 for individual projects (Table 10.1). Almost all the research projects are related to increasing agricultural products on a sustainable basis, which requires addressing many environmental issues related to such things as the use of fertilizers and pesticides, water, and controlling soil erosion.

Power Development Fund

The Government established the Power Development Fund for initial loan financing for promoting hydropower projects ranging from 1 to 50 MW. This is aimed at improving the rural population's access to electricity services. Initial funding of $35 million for selected projects will be provided by the International Development Association. Over time, resources from other international and domestic financial institutions will also be mobilized to develop the aforementioned projects by the private sector. The Fund operates under the direct supervision and management control of the Power Development Fund Board. It is administered by the Power Development Fund Administrator who is selected through competitive bidding. Currently the Nepal Bangladesh Bank has been appointed as the Administrator. For accessibility to the fund, investment projects must be environmentally sound and should have been scrutinized through an initial environmental examination (IEE) or environmental impact assessment (EIA) process as appropriate (PDFB 2005).

Rural Water Supply and Sanitation Fund

The Government of Nepal established the Rural Water Supply and Sanitation Fund in 1996 (B.S. 2052) as per Section 3(1) of the Development Board Act, 1957 (B.S. 2013). The purpose is to develop rural drinking water and sanitation projects sustainably, reliably, and at reasonable cost by mobilizing and providing financial, technical, and organizational

Table 10.1: Major Projects Funded by the National Agricultural Research and Development Fund (NARDF)

Serial Number	Project	Duration	Project Cost (NRs)
1	Improvement in post -harvest handling and ripening of banana s	3 years (Jul '03–Jun '06)	2,073,500
2	Development and dissemination of honey production technology	3 years (Jul '03–Jun '06)	17,21,550
3	Improvement in fruit set of brinjal and chillies	3 years	2,116,000
4	Addressing food security through identification of farmer preferred crop varieties and by strengthening local seed supply system s in the rural communities of western Nepal	3 years (mid-Oct. '03–mid-Oct. '06)	2,858,800
5	Study on the improvement of productivity and production of oilseed crops through integrated crop management practices in t he mid-western region of Nepal	3 years	2,146,800
6	Shiitake mushroom production promotion through entrepreneurship development among hill farmers	2 years	1,845,750
7	Improvement of the vegetable marketing system through farmers cooperative s in Chitwan an d Dhading districts	3 years (Jul '03–Jun '06)	1,595,463
8	Identification and promotion of commercial agricultural opportunities for farmers within the new Hile-Bhojpur road corridor	3 years (Jul '03–Jul '06)	1,760,110
9	Understanding potential and critic al constraints to marketing goats in the western hills of Nepal	1 year 1 Nov. '03–31 Oct. '04	527,563
10	Improving livelihoods of resource -poor farmers through on -farm seed priming in the western hills of Nepal	2.5 years	1,067,200
11	Increase the income , nutrition, and food security of hill farmers through introducing the French bean in maize -based cropping system s	2 years	827,885
12	Development of technologies for year -round production of cucumber in the hills of Nepal	3 years	1,864,150
13	Development of nutrition management strategies to improve the productivity of Pakhribas pig	2 years and 10 months	1,973,837
14	Promotion of wilt management technology on lentil, chickpea, and pigeon pea in mid - and far-western Terai	3 years Jul '03–Jun '06	1,519,265
15	Exploring the formation of well -organized marketing cooperatives in Jumla and Dailekh for promoting commercial production and export marketing of apples and oranges, respectively, including other high value agricultural products	2 years	1,903,025
		Total	**24,100,915**

Source: NARDF (2004)

support to consumer groups and cooperating agencies. This fund is administered by the Rural Water Supply and Sanitation Fund Development Board established on 14 March 1996. It promotes sustainable and cost effective demand-led rural water supply and sanitation services in partnership with NGOs and private organizations, with full emphasis on community ownership in conformity with the Government's Eighth Plan (1992–1997), Ninth Plan (1997–2002), and Tenth Plan (2002–2007) policies.

The Ministry of Physical Planning and Works is the line ministry for the Board. The Board is designed based on the experience of a field testing pilot project, JAKPAS (the Nepali acronym of Janata Ko Khanepani Ra Sarsafai Karyakram, meaning People's Water Supply and Sanitation Programme). The Fund is supported by the United Nations Development Programme and a grant from the Japanese Grant Facility. The World Bank executed a pilot project for three years during 1993–1996, financed by two additional Japanese Grant Facility grants. The Board has completed its First Phase (1996–2003) successfully and entered into the Second Phase (2004–2009) to support rural communities on implementing water supply and sanitation schemes. The Board is being funded by the World Bank, International Development Association, and DFID. The Board has full operational autonomy and is supervised and managed by seven members.

The Board has adopted a demand-led participatory approach for increasing community capacity to sustain the project; enhancement of the role of women in all aspects of the project; and integration of hygiene and sanitation education with technically, environmentally, and operationally sustainable water supply.

Nepal has gained experience in managing this fund. It has been operated to supply additional drinking water and sanitation facilities to the rural poor. This fund also has direct input in improving health and sanitation conditions and reducing the environmental health problems that rural people face.

Funds Generated by Community-based Organizations

There are different types of community-based organizations involved in natural resource management activities. Community forestry programs were launched by the Government of Nepal as early as 1978. They have been implemented more vigorously since promulgation of the Forest Act in 1993. Community forest user groups (CFUGs) have been involved in the development, conservation, and sustainable use of forest resources. The Forest Act 1993 empowers the CFUGs to generate funds from community forests and utilize them for community development. However, the CFUGs have to invest at least 25% of the total income in forest management and development. The total income of CFUGs includes income from the sale of forest products and other sources. About 90% of the total income in the Hills is from the sale of forest products (Table 10.2).

Most of the income has been spent for community development activities, in particular infrastructure development (MOFSC 1993). The CFUGs are spending about 30% on forestry activities such as forest watchers and silvicultural operations. Community forestry has become one of the major sources of income in rural Nepal, and this income has been instrumental in enhancing community development activities.

Another important source of income for natural resource management and community development is from the protected areas, which cover about 18% of the total area of the country and have generated substantial revenue through ecotourism activities. The National Parks and Wildlife Conservation Act 1973 in its fourth amendment in 1993 provides that 30 to 50% of the total revenue generated in the national parks and wildlife reserves be used for buffer zone management and community development activities. In accordance with this Act and Buffer Zone Management Regulations 1996 (MOFSC 1996), the Government has declared buffer zones for 6 national parks and 2 wildlife reserves. The buffer zone area totals nearly 4,300 km^2 out of the country's total land area of 147,000 km^2.

The Buffer Zone Management Regulations 1996 authorizes collection of resources for community development, particularly in buffer zone areas. The protected areas are divided into national parks, and wildlife reserves and conservation areas. The source of revenue is the tourist flow in the protected areas. The national parks are generating more income than the wildlife reserves, hunting reserves, and conservation areas (Figure 10.4). Regarding conservation areas, the Government only manages and collects revenue from the Kanchenjunga Conservation Area, while the Annapurna and Manaslu Conservation Areas are managed by the King Mahendra Trust for Nature Conservation (KMTNC). The amount shown in Figure 10.4 only reflects the Government's revenue.

Buffer zone users are using the funds received for a number of community development activities, including community forestry development, conservation, and management; riverbank protection and compensation to affected families from riverbank cutting; community plantation and conservation; nursery establishment and sapling distribution;

Table 10.2: Annual Income and Expenditure of Community Forestry User Groups (NRs)

Items	Terai	%	Hills	%	Total	%
Income Source						
Forest product sale	143,305,329	59.15	604,074,653	90.40	747,379,982	82.08
GO/NGO grants	4,040,627	1.67	4,040,627	0.60	8,081,254	0.89
Fine/punishment	1,921,990	0.79	2,981,133	0.45	4,903,123	0.54
Membership fees	5,062,717	2.09	6,688,963	1.00	11,751,680	1.29
Entrance fees	2,359,803	0.97	2,417,298	0.36	4,777,101	0.52
Other income	85,487,836	35.29	27,040,978	4.05	112,528,814	12.36
Last year balance	90,253	0.04	20,999,190	3.14	21,089,443	2.32
Total income	**242,268,555**	**100**	**668,242,842**	**100.00**	**910,511,397**	**100.00**
Annual Expenditure						
Forest watcher	27,488,708	14.99	18,674,938	6.83	46,163,646	10.10
Silvicultural operations	31,108,914	16.97	52,773,342	19.29	83,882,256	18.36
Training, study tour workshops	2,908,653	1.59	5,838,382	2.13	8,747,035	1.91
Stationery	3,780,050	2.06	26,556,550	9.71	30,336,600	6.64
Building construction	12,097,447	6.60	17,875,924	6.53	29,973,371	6.56
Rent/equipment	2,004,638	1.09	1,902,831	0.70	3,907,469	0.86
Salary/allowance	13,893,684	7.58	5,494,599	2.01	19,388,283	4.24
Meeting/assembly	7,520,316	4.10	1,390,590	0.51	8,910,906	1.95
Other group operational	0	0.00	226,268	0.08	226,268	0.05
School support	11,120,118	6.07	23,872,342	8.73	34,992,460	7.66
Road construction	995,638	0.54	22,361,760	8.17	23,357,398	5.11
Other infrastructure	18,518,452	10.10	57,491,735	21.01	76,010,187	16.63
Pro-poor program	1,608,566	0.88	11,041,367	4.04	12,649,933	2.77
Miscellaneous	50,301,431	27.44	28,096,062	10.27	78,397,493	17.16
Total cost (NRs)	**183,346,615**	**100.00**	**273,596,690**	**100.00**	**456,943,305**	**100.00**

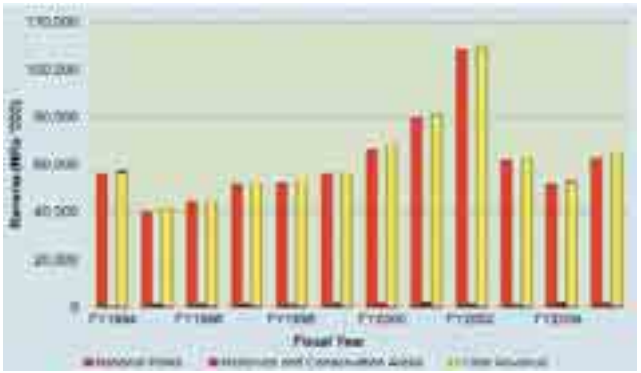
GO = government organization, NGO = non government organization
Source: Kanel (2004)

conservation of endangered species; tourism development and conservation of historical and archaeological sites; and wetland conservation and development within the buffer zone areas.

As empowered by the Buffer Zone Management Regulations 1996, the buffer zone users have also started community savings and biodiversity funds. As the protected areas are set aside for the conservation of biodiversity, buffer zone users have emphasized conserving species of plants and animals in the national parks and wildlife reserves and also in the buffer zones. In four national parks and three wildlife reserves, a total of NRs 62 million have been saved in the form of community savings during 1997 to 2004; of these NRs 26 million have been set aside as a biodiversity fund (Figure 10.5). The biodiversity fund will be extensively utilized for the conservation of legally protected, endangered, rare, threatened, and vulnerable species.

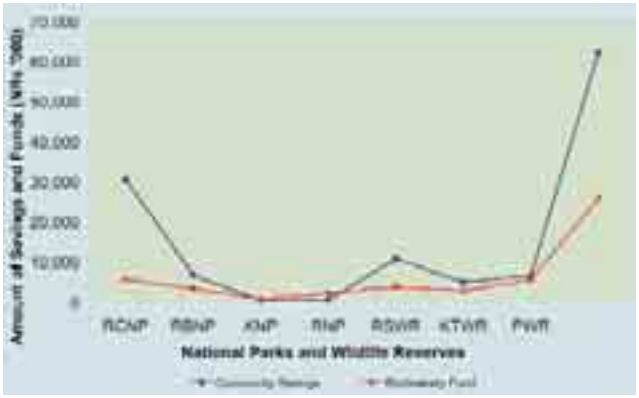
Community development groups have also been mobilized for the conservation of soil and water resources. The Department of Soil Conservation and Watershed Management has promoted the formation of such groups. The Government provided up to 80% of the total cost for terrace improvement and off-farm conservation activities during the early 1980s. As per the information provided by the Department, the Government has been phasing out the subsidies, which had been reduced by about 50% by 2002. The cost sharing is based on the nature of the activity and the magnitude of the problems.

Figure 10.4: Government Revenue from Protected Areas (excluding the Annapurna and Manaslu Conservation Areas)



Source: Ministry of Forest and Soil Conservation records

Figure 10.5: Community Savings and Biodiversity Funds in Protected Areas



KNP = Khaptad National Park, KTWR = Koshi Tappu Wildlife Reserve, PWR = Parsa Wildlife Reserve, RBNP = Royal Bardia National Park, RCNP = Royal Chitwan National Park, RNP = Rara National Park, RSWR = Royal Suklaphanta Wildlife Reserve
Source: Ministry of Forest and Soil Conservation records

These additional incentives and formation of community development groups have been instrumental in encouraging local people to improve natural resources management, particularly soil and water conservation.

The Government has also initiated collaborative forest management since 2003 in selected districts of the Terai with the objective of managing the forests through the joint participation of users, local bodies, and the Government. The major stakeholders include forestry organizations, particularly the regional forestry directorates and district forest offices, local bodies such as district development committees and village development committees, and user groups. The Collaborative Forest Management Manual (MOFSC 2004) provides for establishing both "revolving funds" and "development funds." The former will be utilized for the commercial felling and transportation of forest products (timber and firewood), and the development fund will be used for development activities. The Government has planned to replenish both funds though donor assistance. The development fund will later be converted to a district forest sector investment fund and utilized for intensive forest management.

The Government of Nepal has also developed a mechanism to share the Collaborative Forest Management benefits. Twenty-five percent of the revenue generated from the sale of timber and firewood under the scheme will be deposited in the local fund and the remainder will go to the national consolidated fund. Funds for local use will be dispersed by the District Forestry Sector Development Coordination Sub-Committee, and some portion of this fund will be set aside for the implementation of the Collaborative Forest Management scheme (MOFSC 2004).

The Irrigation Policy 2003 acknowledges people's participation in irrigation development, particularly the involvement of water users associations. The policy outlines the framework for cost sharing for the construction of irrigation canal systems and also provides a framework for ownership development (Table 10.3).

The Irrigation Policy provides the framework shown in Table 10.3. The benefit sharing is based on the workload for management of the irrigation schemes. After construction of the irrigation project, The Government can hand over management responsibility to the water users association, and about 95% of the benefits derived from irrigation fees are deposited into the users' fund. This enhances the possibility for generating more funds for irrigation water management and opportunities for involving the beneficiaries in the process (see Table 10.4). As the irrigation projects are scattered, there are difficulties in fully assessing the funds generated by this policy. However, they are expected to be significant.

Table 10.3: Users' Share in Irrigation Project Construction

Average Irrigable Area	Percentage of Share (of Total Investment)			
	Head-work	Main Canal	Branch Canal	Distribution Canal
Less than 0.5 ha	0	0	0	10
0.5 ha–1.0 ha	0	0	5	10
1.0 ha–5.0 ha	1	3	7	12
5 ha or above	3	5	10	15

ha = hectare
Source: MOWR (1993)

Private Sector Investment

Private sector organizations are also involved in environmental management, particularly for pollution control. Some of the breweries such as Tuborg Beer Company at Nawalparasi District and San Miguel Beer Company at Chitwan District have developed effluent treatment plants to treat their chemical and biological wastes. The Government has also introduced an environmental management system and energy conservation scheme in selected industries with the assistance of Danish International Development Agency (DANIDA) to reduce pollution load at source. Some industries are practicing environmental management systems. For example, the Godavari Marble Factory located at Godavari in Lalitpur district of Kathmandu Valley has joined the environmental management systems program. A number of environmental problems have cropped up during mining and processing of marble. The area experiences the loss of topsoil and plants, noise, and

Table 10.4: Users' Share in Benefits from Irrigation Projects

Participation in Irrigation System Implementation	Sharing of Benefits Obtained from Irrigation Fee (%)		
	Central Maintenance Fund, Department of Irrigation	Government Revenue	Water Users Association
Government-managed scheme (kulo) area before water distribution	40	40	20
Government-managed irrigation canal above distribution canal	30	30	40
Government-managed irrigation canal above branch canal	20	20	60
Government-managed irrigation canal abo ve main canal	10	10	80
Government's involvement only in headwork management	5	5	90
All management responsibility handed over to users	0	5	95

Note: the remaining parts of the kulo or canal are managed by the water users associations.
Source: MOWR (1993)

dust from drilling and blasting activities. During marble processing activities, significant amounts of sludge are also generated. The factory has had to invest in many areas to improve the quality of the environment.

External Sources

Besides national and local level environmental financing, Nepal also receives assistance from the international community and funding agencies.

Grant Assistance from Donors

The Government has continuously received grant assistance in the forestry sector (Table 10.5). The funding ranges from forestry management to livelihood issues. Currently, the Government has implemented forestry development and management programs with assistance totaling slightly over US$ 47 million. In the forestry sector, DANIDA and DFID are the two major donors of recent years. As DANIDA's current support ended in July 2005, DFID will be the most important donor providing grant assistance to the forestry sector.

Similarly, the agricultural sector receives grants from donor agencies for the implementation of agricultural programs and projects. At present, this sector has a total of 14 projects (Table 10.6).

Loan Assistance from Donors

Although the Government has attempted to avoid loan assistance in the forestry sector, it has nevertheless taken about $11.7 million in loans from the International Fund for Agricultural Development to implement the Leasehold Forest and Livestock Development Programme for the period from January 2005 to December 2013.

Tariffs and Subsidies

Tariffs

Tariffs and subsidies for environment and natural resources related sectors are another source of funds. The Government provides subsidies on tariffs/prices for electricity, water supply, community forestry, and community irrigation schemes as incentives for improved environmental management. Many of these initiatives are relatively new.

The Nepal Electricity Authority has implemented tariffs on the consumption of electricity for domestic, industrial, commercial, transport, and other purposes; the tariffs vary by type of use and quantity of energy consumed. It uses the revenues generated through application of these tariffs for extension of the power grid, maintenance and operation of its system, and debt servicing. The Nepal Water Supply Corporation charges tariffs for the use of municipal water and sewage. Currently the tariff on consumption of tapped drinking water is NRs 15.00 per thousand liters. In principle some of this revenue is reinvested to help improve the system. The Nepal Water Supply Corporation and Nepal Water Supply and Sewerage Department develop water supply systems in small towns and hand them over to users' groups. In return for maintaining these systems, the Government provides the users' groups grants of 50%, and loans of 30% (at 8% interest, with repayment in 12 years) from town development funds so that only 20% of the requirements need to be met by the community itself.

Similarly, royalties are imposed on the utilization of forest products, water resources, and others through the licensing process. Through the Forest Act 1993 and the Forest Regulations 1995 (MOFSC 1995) the Government collects revenue on the use of timber and NTFPs and medicinal and aromatic

Table 10.5: Some Major Grant Projects in the Forestry Sector (as of March 2005)

Name	Project Coverage	Funding Agency	Duration	Budget ($'000)
Livelihood and Forestry Project	15 districts	DFID–UK Government	Mar. '01–Feb. '11	26,882
Nepal Australia Communi ty Resource Management and Livelihood Project	2 districts	Aus-AID	Feb. '03–Jan. '06	12,394
Community Development and Forest Watershed Conservation (Phase II)	2 districts	JICA/JOVC	Jul '04–Jul 2005	—
Biodiversity Sector Programme for Siwaliks and Terai	8 districts	SNV	2002–2005	10,690
Participatory Conservation Programme (Phase II)	7 national parks and buffer zones	UNDP	May '04–Dec. '06	1,000
Terai Arc Landscape Conservation Project	Landscape of Terai Arc	WWF Nepal Program	Jul '01–Jul '06	6,000
Strengthened Advocacy for Governed Utilization of Natural Resources Programme	4 districts	CARE Nepal/ USAID	2002–2006	5,600
Western Terai Landscape Complex Project	3 districts	UNDP, SNV, WWF, IPGRI, NARC, LIBIRD	Oct. '03–Oct. '11	12,827
Conservation and Sustain able Use of Wetlands in Nepal	4 districts	IUCN/UNDP	2004–2009	4,988
Churiya Watershed Management Project	2 districts	CARE Nepal	Mar. '01–Feb. '06	1,978
Community Incentives to Reduce Landuse Conflict and Conserve Biodiversity in Nepal	Koshi Tappu WR	GEF/UNDP	2004–2005	194
Natural Resource Management Sector Assistance Programme (Phase I extension)	38 districts	DANIDA	Jul '04–Jul '05	3,846
Sustainable Management and Utilization of NTFPs in the Terai Region of Nepal	3 districts	ITTO	3 years (after agreement)	312

— = not available , AusAid = Australian Aid, DANIDA = Danish International Development Agency , DFID = Department for International Development , GEF = Global Environment Facility , IPGRI = International Plant Genetic Resources Institute, ITTO = Inte rnational Tropical Timber Council, IUCN = World Conservation Union, JICA = Japan International Cooperation Agency, JOVC = Japan Overseas Volunteer Cooperation, LIBIRD = Local Initiatives for Biodiversity Research and Development, NARC = Nepal Agricultural Research Council, SNV = Netherlands Development Organiz ation , UK = United K ingdom, UNDP = United Nations Development Program me, USAID = United States Agency for International Development, WW F = World Wide Fund for Nature
Source: MOFSC (2005)

Table 10.6: Some Major Grant Projects in the Agricultural Sector

Name	Project Coverage	Funding Agency	Duration	Budget
Janakpur Agricultural Development Project	Dhanusa, Mahottari and Siraha, and other Terai districts	Japan KR-2	1972 and yearly	—
District and National Implementation of Agricultural Perspective Plan	20 districts	DFID	2003–2007	£9.87 million
Livestock Service Extension Programme	61 districts		Yearly	NRs 60 million
Crop Diversion Project	12 districts of MWDR and FWDR	ADB	2002–2007	NRs 11 million
Maize-based Cropping System	Maize-based cropping areas	SDC	2003–2007	NRs 2.7 million
Sustainable Soil Management Project	12 districts	SDC	2003–2007	SwF 4.5 million
Agriculture Training and Extension Project	5 districts	JICA	2004–2008	—
Food Security Programme for Nepal	4 districts	France	2004–2007	—
Support to the National Integrated Pest Management Programme in Nepal	31 districts	Norway	2004–2006	—
Himalaya Tea Technology Outreach and Extension Programme		JICA		—

— = not available , £ = pounds sterling, NRs = Nepalese Rupees, SwF = Swiss francs , ADB = Asian Development Bank, DFID = Department for International Development, FWDR = Far West Development Region, JICA = Japan International Cooperation Agency, MWDR = Mid West Development Region, SDC = Swiss Develo pment Co operation
Source: Data from project annual progress reports (2003); MOAC (2003)

From Hands Around Everest book

ICIMOD file photo

From Women, Energy and Water in the Himalayas - Project Learning book

Keshar Man Sthapit

Finance is needed for many types of environmental interventions: bridges to link communities; hazard mitigation; water harvesting; beekeeping training

plants. The Government provides timber to the Timber Corporation of Nepal at subsidized royalty rates approved in 1995. A review of the royalty rates for licensing trade of NTFPs and medicinal and aromatic plants, making them more in-tune with current market prices for these products, could substantially increase the revenue collected. A review of these legal provisions could also ensure that tariffs were levied regularly and that the revenue collected from them was used to directly address different environmental issues around forests. In the case of community forests, users are obligated to spend 25% of the total income earned from the sale of forest products in the conservation and management of the forests at their disposal.

Power developers installing and operating isolated micro-hydro plants and diesel plants for supply of electricity in off-grid areas, as well as community-based users' groups operating with the rural water supply schemes, decide for themselves on the structure of tariffs for the maintenance of their schemes.

The Government, through the Nepal Oil Corporation, the sole importer and distributor of petroleum, oil, and liquefied natural gas, sets the price of these products and provides subsidies on kerosene to consumers in village development committee and rural areas. However, in some locations this must be rethought since higher prices in the border towns of India have caused this subsidized fuel to slip back across the border, while the Nepal Oil Corporation has been operating at a loss of about NRs 3.6 billion annually (NOC 2005). A tariff on petroleum products can be used to combat pollution, and indeed the Financial Act and Regulations do authorize the national environmental agency to collect NRs 0.50/liter on petrol, diesel, and kerosene in Kathmandu Valley to generate funds to combat pollution. It is estimated that about NRs 100 million per year could be collected from tariffs levied on sales of petroleum products in Kathmandu Valley alone. The above process applied throughout the Kingdom could generate as much as NRs 400 million per year.

In recent years, the Government has given priority to the introduction of alternative energy technologies like improved cooking stoves, biogas development, solar photovoltaic, and development of micro-hydro plants in remote areas. The subsidies amount to as much as 50–55% of the installation costs of the systems. By 2004, about 175,000 improved cooking stoves of different types, 125,000 biogas plants, and 250 micro-hydro plants were in use; while around 61,000 families were being supplied electricity by solar photovoltaic modules of different capacity and types (AEPC 2005). The increased application of these technologies is beginning to yield visible dividends on improving indoor pollution and ambient air pollution, and a significant reduction in fuelwood consumption in remote areas, which has also helped to improve the health of the rural population[1].

Biogas

Being an agricultural country, livestock plays an important role in the Nepalese farming system. Cow dung and other bio-products such as plants can be utilized for the production of biogas—a viable alternative source of energy. Nepal has the technical potential for establishing about 1.9 million biogas plants and the economic potential for about 1 million. By the end of 2004, 123,395 biogas plants had been established under the Biogas Support Programme (Table 10.7). About 97% of these biogas plants are functioning at present. The total equivalent power output produced from biogas is 330 MW. It has also contributed to saving 239,386 tons/year of fuelwood, 3.83 million liters/year of kerosene, and 203,478 tons/year of bio-compost. The biogas sector also employs about 11,000 people (AEPC 2005)

The Government initiated biogas development in the mid-1970s on the occasion of "Agriculture Year" when it started funding the development of alternative energy; biogas, micro-hydro, solar energy, and wind energy receive subsidies under this scheme. To promote the development and use of biogas, the Government provided a subsidy of NRs 6,000 for plants installed in Kathmandu Valley, Hetauda municipality, Dang, and Terai districts; NRs 9,000 for plants installed in hill districts; and NRs 11,000 for plants installed in remote districts not accessible by road. In addition, NRs 1,000 is provided for plants below 6 cubic meters (m^3) capacity, and a further NRs 1,000 for plants installed in low penetration districts. The subsidy rate for the fiscal year (FY) 2004 ranges from NRs 5,500 to NRs 11,500 (Table 10.8).

Table 10.7: Phase -wise Production of Biogas in Nepal

SN	Phases	No. of Plants
1	First Phase (1992 –1994)	6,824
2	Second Phase (1994 –February 1997)	13,375
3	Third Phase (March 1997 –June 2003)	91,196
4	Fourth Phase (July 2003 –December 2004)	12,000
	Total	**123,395**

Source: AEPC (2005)

[1] Personal communication with staff of Tribhuvan University's Research Center for Applied Science and Technology (RECAST).

Table 10.8: Subsidy Rate for Biogas Plants

Region	Capacity	
	4 and 6m^3	8 and 10m^3
Terai districts	NRs 5,500	NRs 5,000
Hill districts	NRs 8,500	NRs 8,000
Remote hill districts	NRs 11,500	NRs 11,000

m^3 = cubic meters
Source: AEPC (2005)

Eighteen districts (Achham, Baglung, Baitadi, Dadeldhura, Dailekh, Dhanusha, Doti, Mahottari, Okhaldhunga, Panchthar, Parsa, Rautahat, Rolpa, Rukum, Salyan, Saptari, Siraha, and Taplejung) are defined as low penetration districts for the FY 2006, and these districts receive an additional NRs 500 subsidy per plant.

Conclusion

Although there are complaints of inadequate funds for environmental activities, this preliminary review shows that there is fairly substantial funding from different sources. The direct allocations from the central treasury to national environmental organizations may be relatively limited, but the total amounts from different sources at various levels cannot be considered small. The most encouraging sources are the natural resources organizations and community groups involved in natural resources management. There are also new sources for mobilizing resources such as the pollution tax on petroleum products being used by the transport sector.

At present the financial contribution of urban areas towards resolving their environmental problems is quite limited. Therefore opportunities for enhancing such contributions in the future should be given priority for a more effective management of urban environment. This will necessitate a more exhaustive study of possible potential environmental financing in the future.

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Chapter 11

Environment and Conflict: A Review of Nepal's Experience

Introduction

Human history is rich with examples of conflict that have plundered the environment. Today the imprints of civilizations are not only the deserts from deforestation, soil erosion, and mining but also include sewers of rivers, eutrophied lakes, dumping sites of industrial waste and nuclear materials, and military test sites. Although in the past many quietly suffered the sad consequences of these environmental atrocities, today affected parties are beginning to raise their voices and go to court or even take up arms and stake their claims for righting past wrongs. Environment-related conflict is increasing and attracting attention as a development agenda item along with poverty and human rights. Research to better understand the dynamics of the environment-conflict relationship has increased. Some are trying to understand the linkages, while others are searching for ways to restore peace and cooperation.

At the local level, conflicts are closely related to lack of access to critical resources. With changing prices, markets, and breakdowns in traditional institutional mechanisms for mediation, conflicts have become more the rule than the exception in the use of forest, water, pasture, and other natural resources. While many of these local conflicts are not violent and are resolved peacefully, in other cases disagreements and tensions are very high and violence has erupted in some (Homer-Dixon 1999; Conca and Dableko 2002).

At the national level, mainstreaming the environmental agenda, adoption of livelihood-based approaches to poverty reduction, and the move towards greater democracy and human rights have strengthened efforts to overcome past environmental injustices. Development has not only displaced many groups of people in the past, but has also failed to provide adequate compensation. Today there is increasing discussion about who benefits from development, who loses, and the transparency of the underlying decisions. Development projects may increasingly become subjects of court battles to safeguard the traditional environmental entitlements of people whose livelihoods have been closely linked with the diversity of environment (PANOS 2002).

At the global level, many international agreements such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) 1973 and the Convention on Biological Diversity 1992 have tried to curb trade in endangered flora and fauna. With high stakes in some environmental products, conflicts are rampant in many areas with shared ecosystems and shared resources like water (IDRC 2005; APCSS 1999). Efforts to exploit resources have been a source of unending conflict in some parts of the world (Ehrlich et al. 2000). Problems related to the management of the global commons—air, climate, oceans—have also become a source of continuing conflict, fortunately not a violent one so far.

The issue of environment and conflict has become serious at all levels of society. While there is growing recognition of the problems, ways to deal with them are less clear and filled with controversy. This chapter will review the changing environment-conflict nexus generally and for Nepal in particular. Before discussing the Nepal scene, it is necessary to summarize recent discussions on this topic. The situation in Nepal clearly indicates that conflict conditions are abundant. However, while some are quick to identify the "green roots of the red rebellion" in Nepal (Bhurtel and Ali 2003), some caution is necessary in trying to establish a cause and effect relationship in this complex issue.

Environment, Resource Scarcity, and Conflict

Webster's Dictionary defines "environment" as "the totality of the physical conditions of the earth or part of it, especially as affected by human activity". It includes all ecosystems. "Ecosystems" are defined as "a dynamic complex of plants, animals, and

microorganism communities and the non-living environment interacting as a functional unit" (MEA 2003). Humans are an integral part of most ecosystems. Whenever changing socioeconomic conditions affect the continued access or use of ecosystems by some groups relative to others, there is the potential for conflict if the problems that ensue are not resolved in a satisfactory manner. Every society must have institutional mechanisms to deal with changes, or unresolved problems can easily turn into serious conflicts; and the mechanisms must be maintained as solving one problem does not mean that new ones will not emerge.

Renewable and Nonrenewable Resources

Some authors consider that only exploitation of renewable resources should be considered in the case of an environmental conflict (Libiszewski 1995). Renewable resources are important because they are linked to life-supporting processes. Exploiting non renewable resources such as minerals depletes but does not necessarily degrade the environment, but the potential for environmental damage is certainly high. The violent movement to secede Bougainville island from Papua New Guinea began over environmental concerns at a large copper mine (MEG 1996).

Resource Scarcity

Four types of resource scarcity have been identified (Libiszewski 1995). Physical scarcity is the most commonly experienced type; because of the limited nature of a physical material, its increasing use increases its relative scarcity. There tends to be intense struggle for control of all valuable resources, which can lead to conflict if negotiations fail.

Notions of physical limitations with respect to most resources, however, are relative. While some resources such as sunlight and ecosystem processes that support life cannot be substituted, based upon our present knowledge and capacity, and therefore must be taken as finite, other natural resources have been substituted for over time. Substitutability is an important dimension in the discussion of the scarcity of natural resources (Swanson 1996).

The next type of scarcity arises from prevailing socioeconomic conditions. It is referred to as distributional scarcity. Societies have distributed natural resources (such as land) in different ways, and some distributions are more equal than others. Where there is inequality in distribution, some groups face scarcity and have limited access and ownership of natural resources such as land, forest, and water.

Geopolitical scarcity is another dimension. Some countries have plenty of some resources while others may lack them. The concept of "resource" is an economic one. There was a period when crude oil was seen as a nuisance because the knowledge and the technology to use it were lacking (Swanson 1996). Trade has alleviated scarcity of a resource in any one place. However, genuine instances of scarcity in particular countries need to be recognized.

The fourth type of scarcity is environmental scarcity. This is related to the environmental degradation that may take place. A resource that used to be plentiful is no longer so because of changing environmental conditions brought about by improper management of natural resources, over-harvesting, or institutional failure. For example, fresh water that used to be abundantly available in urban areas is becoming increasingly scarce because of pollution, poor management, and waste.

According to Libiszewski (1995) an environmental conflict is one caused by environmental scarcity, because of its roots in the environmental problem. Other types of scarcities have their roots in socioeconomic and political issues and not in environmental ones.

In real life it becomes very difficult to isolate environmentally rooted problems. Most problems are dynamic and quickly impact other areas. Shortages of diesel fuel generate shortages in other areas. Even if we agree that environmental conflict is rooted only in environmental scarcity, the solutions must often be found in other sectors and resources. We cannot avoid examining the entire spectrum of interrelated factors and processes.

Different Types of Conflicts

As is evident from the above discussion, there may be some debate about what constitutes an environmental conflict as opposed to a civil strife. Conflicts are also of differing degrees. Some are very violent while others are almost routine disagreements related to day-to-day activities in communities. For the purpose of this discussion, conflict is interpreted in a very broad sense as any state of opposition or hostilities between parties over some aspect of the environment. In its broadest sense it is possible to distinguish a number of possibilities.

Conflict over environmental resources is probably the most common type of conflict today at the local, national, and regional levels. All conflicts between different parties regarding the use and ownership of land, water, minerals, and such like belong to this category.

The next type of environmental conflict is differences over understanding the problem and the measures to cope with it. An example of this would

be the differences in countries' positions regarding global warming.

The third type of conflict may occur when civil strife impacts environmental resources. Conflicting parties may initiate deforestation for their own reasons, or may want to control the use of certain environmental resources.

Theories Behind Environmental Conflict

The world is experiencing changes in the prices of goods and services, technology, socioeconomic conditions, demand, and regional and international trade. Accordingly, the concept of "scarcity" cannot be viewed as an absolute. Economies are increasingly moving towards specialization in their areas of relative advantage, hoping to overcome the scarcity of any particular resource through international trade. Given this trend, how can we explain the scenario of increasing environmental conflict over natural resources? It is useful to review some of the theories that explain environmental conflict.

Pressures Related to Population Growth

Rapid population growth has long been considered one of the most important factors behind deteriorating environments and ensuing conflicts. The world population is expected to stabilize around 2050 at approximately 8.9 billion; much of the increase will continue to be among the less developed countries where people depend on subsistence agriculture and the use of natural resources for their livelihoods (UN 2003). The use of marginal lands for agriculture, increasing soil erosion, deforestation, overgrazing, declining soil fertility, and decrease in land productivity are some of the major issues that derive from rapid population growth. The sheer increase in population is likely to outstrip available food supply and the capacity of natural systems to support human needs (Ehrlich et al. 1997)—a strong basis for much of the conflict.

However, some consider that human population growth made a turning point around 1962/63 when growth peaked at 2.2% per annum (UN 2003). Since then growth has continued to fall, and in 2001 it was only 1.2%. If this trend continues, human population will stabilize sooner than expected. However, this does not mean that all environmental pressures and conflict will disappear; if population is one factor behind increasing use of and competition for natural resources, the other is increasing demand through over consumption, including unequal distribution and access to resources.

Neo-Malthusian notions of scarcity maintain that population pressure is behind the growing scarcity of natural resources (Gleditsch 2004). High levels of consumption have led to overexploitation and depletion of resources, increasing competition for scarce resources, and eventually leading to conflict and at times even violent conflict. Thomas F. Homer-Dixon (1999), a prominent advocate of this position and one of the better-known figures in the analysis of environment and conflict, maintains that environmental scarcity is likely to promote internal conflict. Related to rapid population growth, there is also a youth bulge in some societies. As there are few outlets for the productive engagement of youth, they become vulnerable to depressing economic conditions and easier to recruit for violent activities than other age groups.

South Asian countries with large and poor populations impose a substantial demand on water, arable land, forests, and other resources. Already problems such as deforestation, soil erosion, and scarcity of fresh water are widespread and the area is being seen as a region of high environmental instability (Swain 2002).

Policies, Markets, and Institutional Failures

Explanations about resource-related conflicts have focused on the issue of common property resources. Where institutional mechanisms for managing the resource are weak, such as the absence of well-defined property rights, it is inevitable that the "tragedy of the commons" will occur (Hardin 1968).

Put simply, the tragedy of the commons states that when all members of a group have equal and unlimited access to a resource held in common, that resource will inevitably be depleted. However, instances of collectively well-managed natural resources do exist; adherence to principles of equity and institutional variables have been important in such cases (Jodha 1986; Ostrom 2000). Economists have attributed the tragedy of the commons to a failure of markets—the price mechanism fails to signal the relative scarcity of a resource—and to the failure of institutional mechanisms (Mason 1996). If the price mechanism always worked, overexploited resources held in common would provide incentives for better management because of the increase in the value of these resources. This would be the opposite of conflict, but this does not occur because institutions are not able to function quickly in response to complex situations. Solutions are not easily apparent, or involve a price that some members of society may be unwilling to pay. There may be problems of high transaction costs. Certain policies may now favor some groups through

subsidies (Mason 1996). All these are different aspects of institutional failures which if not resolved in a timely fashion, can lead to conflicts over resources.

Human activities tend not to take into account the true costs to the environment. This may be due to government subsidies, lack of knowledge of impacts (especially if these are ex situ), the absence of laws and regulations to control environmental damage, undefined access rights to natural resources, conflict situations where both parties do not observe environmental safeguards, poorly developed markets for environmental goods and services, and a lopsided development that forces large numbers of people to depend on limited natural resources for their livelihood. Market failure occurs when resources are not used efficiently based upon market signals or because of externalities (Mason and Swanson 1996). In many instances, markets are unable to put a price on outputs or the impacts of activities. This situation pertains to many environmental problems such as disposal of waste in water bodies, dumping toxic substances, or polluting the atmosphere. This happens either because polluters think they can get away with it, or the costs of proper disposal are too high. The social costs in this case can be much higher than the costs to a private producer.

Solutions to the problem lie in making the price signal work more effectively by taxing the producer for the pollution. Permits provide permissible quotas of pollution beyond which fines can be imposed. In some cases, when pollution levels are lower than the permitted levels, the industry can also sell part of a permit to another polluter (EPA 2005).

Examples of policy distortions include subsidies and protections given to certain industries that damage the environment. Many public sector industries with high degrees of pollution continue to operate only because of the huge subsidy and protection provided by governments (UNEP 2002). Other distortions arise because of the huge administrative and transaction costs involved in getting government approvals, licenses, export and import permits, and so on.

Conflicts here may be more implicit than explicit. But as societies realize the long-term consequences of environmental damage, affected groups are playing a bigger and bigger role.

Other Theories Regarding Environmental Conflict

Another explanation holds that the inequities of the world's economic systems and the process of globalization are responsible for the increasing number of violent environmental conflicts (Matthew et al. 2004). The world's trade system has always been biased against natural resources export from the developing countries (Khor 1996). Timber exports have uprooted many indigenous communities from their traditional homes and damaged their livelihoods. Many have had to fight against these companies.

Having plentiful resources is a curse for some countries as it provides a favorable base for environmental conflicts (Gleditsch 2004). Where resources are abundant, there is a tendency to misuse them. Slow economic growth despite plentiful resources, skewed distribution of development benefits, and weak institutions provide a set of factors that encourages political instability and armed conflict for control over resources. These have also been referred to as the "greed and grievance" theories (Gleditsch 2004). The motivation for conflict in the grievance theory is the opportunity to right past wrongs, while in the greed theory the motivation is for seizing the resource through violent means. It is also necessary to distinguish different types of natural resources. The more valuable the resource, the more likely that it could become a source of conflict.

Efforts are being made to examine ways to resolve conflicts through promoting cooperation and peace building (Dabelko and Carius 2004; Conca and Dabelko 2002). There is little value in explaining conflicts if those explanations do not identify or lead to a peaceful resolution of the problem. So far most conflicts have affected rural areas, but there may also be conflicts that affect urban areas in the future, especially with the growing scarcity of fresh water and clean air (Matthew et al. 2004). Conflicts need not always be negative. They may provide valuable experience for innovative solutions to natural resources management.

As increasing competition for valuable environmental resources becomes the cause of conflict at a larger scale than at present, there is growing interest in "ecological security" (Conca and Dabelko 2002). Increasingly, developed countries are carefully tracking the availability of critical natural resources, assessing the chances for eco-violence, and urging their governments to develop ecological security guidelines and policies. Developing countries, on the other hand, see this as another hurdle being put before them by the developed countries in their efforts to promote sustainable development. Any limitations on harnessing available environmental resources could jeopardize their prospects for improving the wellbeing of their people (Conca and Dabelko 2002).

Environmental Conflict in Nepal: The Overall Context

Judging from the paucity of published materials, it is clear that Nepalese scholars have not given much attention to the issue of environmental conflict. Attention to environmental conflict has been mainly limited to the conflict between people and protected areas, but recently some concerns have been raised about the impact of political conflict on the environment. The issue that has attracted the most attention is the poaching of endangered wildlife and trade in endangered wildlife species banned by various international agreements (American Embassy 2005; Hakahaki 2060 [2003]; Murphy et al. 2004).

The complex interrelationship between environment and conflict makes it difficult to bring together relevant facts, and the scope of the present exercise does not give the flexibility or the time to deeply analyze these critical multidimensional aspects of environment and conflict. In many respects, conflicts indicate that existing social relationships are beginning to change (Banskota and Chalise 2000; Pradhan et al. 2000). For an agrarian economy like Nepal, environmental relationships may be at the root of changing social, economic, and political interactions (Bhurtel and Ali 2003). Some forces may be on their way out, some may still be emerging, while others might have clearly established their foothold until new pressures begin demanding further changes.

The available evidence has been brought together in the following to describe the different dimensions of environment and conflict in Nepal, bearing in mind its limitations.

Nepal is and has been an agrarian economy with over 80% of the people still dependent on agriculture for their livelihood. Given that landholdings in Nepal have been distributed very inequitably (Yadav 1999; Aryal and Awasthi 2003), there is a huge land hunger in the country. The poor are squeezed onto small and marginal landholdings of less than one hectare that can barely support a family's needs for a few months of the year. There is intense and widespread competition for available natural resources, leading to conflicts for space, ownership, and control. The average size of landholdings has decreased despite bringing large tracts of forest land under cultivation. The skewed land distribution system has remained virtually intact despite numerous policies to bring about land reform. Acute problems of insecure tenancy have resulted in conversion of large numbers of tenant farmers into wage laborers. The large increases of institutional credit to the agricultural sector have not helped the poor who are still unable to access it (Bhattarai and Pradhan 2004). All these factors have contributed to increasing pressure and conflicts regarding all the important natural resources of Nepal.

The rapidly increasing population has played an important role in this scenario because development efforts have not succeeded in diversifying the economic base of the country to the extent necessary for its rising population. Nepal's geography, with its very distinct ecological belts and the fragility of the Hill and Mountain areas, has also contributed to the increase in competition and conflicts. Prior to the eradication of malaria, which was endemic to large parts of the plains, the lowlands of Nepal were sparsely populated. Most of the population lived in the climatically more favorable and less disease-ridden Hills, where many struggled to eke out a survival often supplemented by seasonal migration to India. Malaria eradication during the 1950s opened the flood gates to migration from the Hills to the Terai, giving many an opportunity for a better life. However, for some it was an unending set of problems—sometimes with the Government and at other times with other migrants from the Hills and neighboring parts of India (Panday 1985).

This opening of the Terai plains after malaria eradication was a politically unstable period. Frequently changing governments, each wanting to take maximum advantage of the opportunity of new land available in the Terai, established commission after commission to look into the problems of land distribution and settlement. Groups of illegal settlers, landless groups, insecure tenants, and interestingly enough "political sufferers" actively pressed their claims to land ownership. Depending on who was in power, decisions favored one group and angered others, resulting in many demonstrations and clashes, some of which were violent (Ghimere 1992). A major land reform launched in 1964 had a few notable aspects, but many later reviews (IDS 1985; SEEPORT 2000) were quite critical of its approach. Land reform is still a hot issue and an important agenda item of all political parties, but as in the past, despite strong rhetoric, actual achievement has been minimal.

The latest case is that of the *Kamaiyas* or bonded laborers in southern parts of far western Nepal. In July 2000, the Government declared the Kamaiya system illegal and freed the laborers of the Tharus living in the Terai and inner Terai districts of far western Nepal (Global IDP 2004), an area that had been the scene of many forest and settlement related conflicts in the past. Freeing them, however,

addressed only part of the problem. Feeding, housing, providing new land for settlement, access to credit, and other inputs to begin their farming had not been given adequate attention. What has been offered in compensation has been woefully inadequate to resolve the day-to-day plight of these people. "The Kamaiyas have since grabbed more that 10,000 acres of government forest land against the state's failure to rehabilitate them, more than four years after their release" (Global IDP 2004). Delays in providing land were caused by a conflict between the Ministry of Forest and Soil Conservation and the Ministry of Land Reform (Global IDP 2004). Initially there was no plan to allocate any forest area to them, but now this appears to be unavoidable.

One estimate (IDS 1985) puts the number of landless families in Nepal at one million, with most of these belonging to low caste and indigenous groups in the Terai, displaced people from the Hills, and even some labor migrants from India.

> In terms of property rights and entitlements to productive assets and natural resources, the farmers of Nepal have limited access to such resources. Land and land based resources have served as the principal source of economic surplus generated by the ruling class. Concentration of land, and exploitation of the peasantry through excessive expropriation of labor and land revenue has increased the wretched condition of peasantry. (SEEPORT 2000)

Unless these problems are addressed comprehensively, green conflict in the form of land grabbing, illegal settlers, eviction of people occupying forest areas, and issues of resettlement and displacement could easily become an inseparable part of the violent movement going on in the country.

Forest Resources and Conflicts

Forests cover over 30% of the country. Including shrub area, the share of forest goes up even more. Forests provide about 14% of the gross domestic product (GDP), 80% of the fuel, and 50% of livestock fodder (Uprety 2003). In the agrarian economy of Nepal, forests play an enormously important role. As forests of the Hills have been intensively used and are now more carefully managed, the attention for the past five decades has been on the forests of the Terai plains for settlement, agriculture, timber extraction, infrastructure development, establishment of protected areas, and many other purposes.

Nepal's community- and state-based forest management practices have been protection oriented. Managing a finite resource in the face of rapidly increasing demand will not be easy, and there will be gainers and losers. Where there are few losers their voices will be subdued, but once the number begins to increase, the flags of conflict will begin to wave far and wide. It has been argued (Grosen 2000) that if forest management moved towards an active production orientation, the current contribution of $58 per hectare could go up to $162 per hectare. With increased productivity, the forest sector could play a major role in poverty reduction and in dealing with the problems of illegal settlers, landless groups, and others by providing employment opportunities. On the other hand, if forests are managed as they are now, with low productivity and a protection orientation, they could become an even greater source of conflict in the future.

Illegal Settlements in Forest Areas

Many of the problems of the agricultural sector are transferred to forest resources. People's hunger for land during the past five decades has been met largely by bringing more forest area of the Terai under cultivation (IDS 1985). Many of the ongoing conflicts regarding tenants, landless groups, and illegal settlers have occurred in occupied forest areas (Ghimere 1992). Many of the new settlements in the Terai have also come from cleared forest areas. Ghimere (1992) discusses the experience of Nawalparasi district, pointing out that given the high demand for land and the relatively low cost of resettlement, the Terai provided an excellent option for people in the Hills as well as those across the border in India.

Many Nepalese from Assam and Myanmar were encouraged to return and settle in this area (Ghimere 1992). On the other hand many of the earlier residents were dispossessed of their lands through very unpleasant means, and illegal settlements were officially encouraged although the landless people were never a target for settlement.

The resulting chaos in land ownership, dealt with only cosmetically by numerous commissions set up to look into problems, has been the basis of longstanding tension between landowners and landless groups, richer landowners and marginal and small farmers, and local groups and immigrants (Ghimere 1992). Although these issues appear in many Terai districts, they are most prominent in the west, the far west, and around protected areas of the country.

Forest and Other Legislation

Many contradictions between forest and other legislation are sources of problems and confusion.

Some of these have remained unresolved for decades (Grosen 2000), which only shows the extent to which governments have been unconcerned about removing conflicts. Research should clarify who benefits from these legal contradictions and their impact. There has been a rush to pass new laws, but few efforts to ensure that new laws do not conflict with earlier ones. Based on the many continuing contradictions, it is obvious that a new commission is urgently needed to look into this very serious matter.

Some of the more obvious conflicts related to the use of forest resources are listed below (Grosen 2000):

(i) There are differences in the amount of land that can be owned under the Forest Act and the Land Act. It would be interesting to see how many cases have been recorded because of these conflicting provisions.

(ii) The absence of a cadastral survey in many areas has made it very difficult to separate private and government land, and thus made it very difficult to identify encroached lands. Similar confusion has been noted among community forest groups.

(iii) Provisions under the Forest Act and the Nepal Mines Act overlap. The Forest Act maintains that anything in a forest is governed by the Forest Act while the Mines Act maintains that all minerals are governed by the Mines Act.

(iv) Provisions have been made for compensating landowners when property is acquired for development schemes, but as land demarcation is not clear compensation has often remained pending for a very long time.

(v) Similarly, many overlapping provisions have been found between the Forest Acts and the Local Self Governance Act, which has greatly hampered decentralization. The central agencies responsible for the different Acts have not removed provisions regarding local resources, creating overlapping jurisdiction and confusion for the public.

Problems in Community Forestry

Although community forestry has been a successful model for community-based management of forest resources in the Hills, it has not been completely free of problems. While it was a very innovative approach for rescuing parts of the hill forests from further degradation, which accelerated after the Government took over all the forests in the country, over time new challenges and difficulties have been identified (Britt 2002).

Problems within forest user groups

Formation of forest user groups has been an important feature of the community forestry program. There has been an increasing tendency to form groups without adequate homework regarding group harmony based on traditional interactions within the community. Exclusion of community members who belong to low caste and disadvantaged groups, as well as those who may be part-time users, is leading to tension in forest user groups. Rules regarding sharing of benefits and costs have always been a major source of tension. Questions of personality clashes, differences between active and inactive members, and fund misuse and embezzlement are other problems noted in hastily formed user groups (Bhatia 1995; Springate-Baginski et al. 2003).

Problems between user groups

One of the most common problems between user groups has been confusion with respect to the forest area. Without clearly identifiable boundaries, there is overlapping jurisdiction, and without good base survey maps the problems are arbitrarily put on hold to resurface again. Because of the lack of good maps, there have been instances of mistaken handover of forests that are temporarily resolved after intense negotiations involving cumbersome administrative and legal processes (Bhatia 1995; Springate-Baginski et al. 2003).

Problems Between Forest User Groups and the Forest Office

The Forest Office has many discretionary powers, and without its active support, approval for a community forest group may never come. Many requirements need to be fulfilled before the Forest Office can provide approval, and each of these requirements can be a source of difficulties for the user groups. Over time a lot of experience has been gained by user groups, but if the Forest Office imposes difficulties, this experience may not be useful. Traditional mechanisms for resolving local conflicts have weakened for a number of reasons. Having access to the Government and getting timely decisions can be very difficult and costly for weaker groups without the right political linkages. A study of land disputes (New Era 1989) showed that tenants had to pay substantially more court expenses than landlords, and also encountered more delays.

Community Forestry in the Terai

Attempts have been made to introduce community forestry in the Terai, which unlike the Hills has no

historical practice of community-managed forest resources. The objective of introducing this practice was to prevent further degradation of forests and to improve the quality of existing forests for the benefit of the local community. However, the experience so far has not been very encouraging. The Government maintains that the Terai lacks the ecological and social conditions needed to make community forestry work, while others argue that the government programs did not do enough to provide ownership and local institutional development, and failed to target those who would have benefited (Britt 2002). Community management of Terai forests faces an uncertain future with significant difficulties for local communities to legally use forest resources in their areas.


C. Richard


IUCN


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Poaching of Endangered Species and Overharvesting are a Major Source of Local Conflict

Customary Practices and Forest Acts

With the implementation of national Forest Acts, the fate of all customary practices is open to question. In some cases (Pant 2002), respect for customary rights was negotiated as part of a package recognizing the authority of the rulers in Kathmandu. However, the context has changed to such an extent that the current position of many customary rights is not clear. In some instances local communities still assert that their customary privileges are valid but the Government has a different understanding (Pant 2002). Some traditional practices are important because of the size of the group and area involved. The most obvious case is the traditional *kippat* system of land holding among the Rai and Limbu community in the far eastern Hill and Mountain areas. It is a system of communal land management where the community members have the usufruct right to use the pasture but no powers to sell it. This right was recognized by the Government in return for their submission to the authority in Kathmandu (Pant 2002). However, while the people have accepted community forestry, they are not abiding by its rules. Under community forestry rules, there are restrictions on non-forest uses of the community forest land, especially for cultivation of new crops, although this is also a subject of discussion. The forest areas are now being used for cultivation of cardamom. When locals are questioned they maintain that their kipat heritage gives them the freedom to use the forest in any way they decide, but the Government understands the situation differently. The existence of this dual system has perpetuated tensions and severely limited the opportunities for further development of forest resources (Uprety 2003).

Traditional practices of indigenous groups have been replaced by state laws. Sometimes these changes take a very heavy toll on the livelihood of the indigenous groups because the new laws have opened access to outside groups. The resources traditionally enjoyed by indigenous groups are then quickly depleted or controlled by more powerful outside groups. The plight of the *Rautes*—one of the last remaining groups of forest dwellers of Nepal—is a sad example. These people roamed the jungles in search of food, hunting and collecting edible products, and making wooden products which they exchanged for food grain in the villages. Today the forest they used cannot provide for their needs and they are often hungry—some children have died of starvation (The Rising Nepal 2004). In the case of

Factors that Could Reduce Local Conflicts in Natural Resources Use

Community Participation

Harnessing Indigenous Knowledge

Mobilizing Community Participation

Working Together

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another semi forest-dwelling group near the capital, the story is a little more positive. Leasehold forestry has successfully restored over 7,000 hectares (ha) of degraded patches of land, and 1,600 leasehold forestry groups are nurturing forests on otherwise hopeless slopes and ravines. The livelihoods of the poor have improved, and empowerment of women has advanced (IFAD 2004).

Conflicts in Parks and Protected Areas

Nepal has had a long and successful history of establishing protected areas. The Royal Chitwan National Park was established in 1973 and the latest protected area—a buffer zone, for Sagarmatha National Park—was approved in 2002. Both are recognized as World Heritage Sites. To date Nepal has nine National Parks, three wildlife reserves, one hunting reserve, three conservation areas, and six buffer zones. A total of 26,970 km^2 (18% of the country) has been set aside, of which 38% is national parks, 4% wildlife reserves, 5% hunting reserve, 43% conservation area, and 10% buffer zone. Three wetland sites have also been recognized recently as Ramsar sites—Beeshayar and associated lakes, Ghodaghodi lake, and Jagadishpur Reservoir—in addition to Koshi Tappu. Protected areas contain at least 80 of the country's 118 ecosystems, which helps preserve Nepal's biodiversity (CBS 2004). However, so far no comprehensive study has been carried out of the actual flora and fauna contained within these protected areas.

Shrestha (2001) points out that the Government has followed a number of distinct phases in the management of parks and protected areas. During the 1970s and 1980s the policy was to exclude people from these areas. In the 1980s, conservation areas for ecotourism were promoted. During the 1990s the focus shifted to resolving park-people conflicts through buffer zones and other programs to better integrate people in the conservation and sharing of benefits of protected areas.

Nepal and Weber (1993) have identified a number of major conflicts between parks and people. These include illegal extraction of park resources such as firewood, fodder, timber, livestock grazing, hunting and fishing; frequent crop raids by wild ungulates; and loss of human life and property. In the early years, the problems were few and infrequent. However, with rapid increases in population and settlements around protected areas, the conflicts have increased in number and severity—at times entire villages have had to be

moved or relocated. The fact that since 1996 buffer zones have been declared around six of the national parks is an important indicator of the extent of this conflict and the Government's response to the problem. However, many problems still remain. The open boundaries of parks have facilitated the entry of domestic animals into the National Parks in the absence of alternative sites for grazing. Wild animals in turn are attracted by the domestic livestock. The desperate situation of people around the park is indicated by one of the comments of the resident near a park: "Unless a suitable solution is made, we will continue our illegal activities regardless of the price or penalty we will have to pay" (Nepal and Weber 1993). A similar finding is made by another review (IUCN Nepal 2004) which points out that wildlife reserve-people conflicts are serious because people lack viable alternative livelihoods to compensate for the loss of access to natural resources inside the reserve, and the customary rights of the people have been ignored.

Because the bigger animals such as elephants and rhinos raid crops, and others such as tigers kill livestock, locals are only too eager to get rid of these animals, which often become easy prey to poachers who need local support. Elephants, although few in number in Nepal, have become a regular menace and a permanent source of tension in the eastern plains.

> The true outcome will not be determined for sometime, though if the current trend continues, it seems most plausible that the elephant population will continue to diminish and the conflict will be resolved by its destruction (Bosley et al. 2000). With the break in the ecosystems, mega fauna that need larger spaces and have seasonal movements are coming into increasing contacts and conflicts with human settlements. (WWF 2003)

Conflicts in Trade in Non-timber Forest Products, Medicinal and Aromatic Plants, and Wildlife Products

Nepal is home to many non-timber forest products, medicinal and aromatic plants, and wildlife species because of its rich biodiversity. NTFP and medicinal and aromatic plants products have been harvested since time immemorial and are important in many local rituals and healing practices. Traditionally, many of these have also been exported to India. Trade in wildlife products is more recent and because of its more lucrative markets is also more prone to violent conflicts. Trade in all of these products was generally free until recently. Some have been brought under government control to conserve biodiversity, others have been regulated because of revenue considerations, and still others like wildlife products have been controlled because of bans imposed by international conventions on trade in endangered fauna. This control has created problems for people who have been dependent on harvesting these products for their livelihoods. There is confusion in policy regarding different aspects such as royalty payments for non-timber forest products, and medicinal and aromatic plants that are not cultivated (Tiwari et al. 2003).

There is no mechanism in place to certify origin, and in its absence, royalties are imposed on all products without a careful study of the different margins. This has made it very unattractive for the collector. In trying to avoid royalty payments, large parts of the trade have moved underground, resulting in constant tension in areas where these products are collected.

Trade in several wildlife products is completely illegal, but because of the huge premiums for some of the products this has not only increased the risks for some endangered animals but also for the people who live around the areas where these animals are found. Poaching around national parks is a full-time but risky activity for some people (Nepal and Weber 1993).

Nepal has also been identified as a safe passage for trade in wildlife products (Asia Rain Forest Conservation News and Information 2000). While authorities are making regular seizures of endangered wildlife parts (World Environmental Journalist Egroup 2002), there is increasing danger that this lucrative trade can get out of hand with heightened insecurity all over the country. Even if the local people are not involved, its escalation could also affect them.

Water Resources and Conflict

Nepal has so far been seen as a country with abundant water resources, at least in terms of endowments. However, as the country harnesses more water resources, many different water-related conflicts are becoming evident. Irrigation area increased from 729,886 ha in 1994/95 to 943,860 ha in 2001/02 (CBS 2004). Public water supply from different sources increased from 62.2 million liters per day in 1994/95 to 228 million liters in 2001/02 (CBS 2004). This increasing demand and supply has not been smooth. Conflicts have been identified at the local level regarding water rights and sharing of water between different user groups. In urban areas, scarcity of water, water pollution, and rural-urban water linkages are sources of conflict. At the national level, mega water projects have created much

tension and conflict (Dixit 1994). Although India and Nepal share many common river basins, they have not succeeded in developing a mutually agreeable basis for harnessing water resources. Some of these aspects are discussed below.

Rural Water Issues

Water rights in rural areas have closely followed land rights (Banskota and Chalise 2000; Pradhan et al. 2000). The distribution of water rights is almost a mirror image of the prevailing skewed distribution of landholdings. Within the landholding groups, however, water rights are not static and are changing due to various circumstances. Changes in landholdings, particularly their fragmentation, have increased complexities of water distribution. Similarly, one-crop systems are moving quickly to multiple-cropping systems that produce crops throughout the year, increasing water demand and placing maximum strains on limited supply, weak delivery channels, and informal management structures. In many instances disputes may remain largely implicit and dormant (Pradhan et al. 2000).

Conflicts among different groups are also quite common. Religious laws with their implied rules of cleanliness and untouchability regarding water, and resulting exclusion, have created much difficulty for lower caste people and untouchable groups (Pradhan et al. 2000). Differences over water use, regulation, its transport, and related activities are not uncommon between landed and landless, between rich and poor farmers, between upstream and downstream farmers, and sometimes also between the community and the state. Although local water user groups have been an important innovation for managing local water resources, they are not free of conflicts. There are important questions of equity between members who have different status and resources. While benefits from the use of water are proportional to landholdings, cost and other contributions are generally equal among members. Even when smaller holders object to this, these systems are not easily altered (Matrin and Yoder 1987). Another aspect of the conflict is between different water user groups when they share the same source (Pradhan 1990). During peak demand for water, there are inevitable tensions as supply is never adequate. Other sources of tension are changes in cropping patterns and cropping intensity. Political groups have always been very willing to emphasize water issues during elections.

Historically, water rights have rested with the community and local sharing rules, and have been modified by the community over time as a response to changing circumstances. The Water Resources Act of 1992, however, changes this by asserting that all water resources belong to the state. Pradhan et al. (2000) argue that this is the opposite of what has happened in land rights, which over time have moved from the state to the individual. This legal assertion of state ownership is very significant in the context of agreements with the private sector regarding investment in water resource development.

Urban Water Problems

A number of water-related conflicts have begun to emerge in the urban areas of Nepal. There are a number of acute problems relating to adequate and safe supply of water, pollution of existing water bodies, and finding ways to augment present supplies. Kathmandu's experience has been very mixed, and satisfactory solutions are still not in sight (MOPE 2000). The conflict here is more implicit—between rich and poor, present and future generations, urban and rural residents. Richer urban residents may be able to pay a higher price for water but may also succeed in making the nation pay for very costly projects.

First is the problem of adequate and safe supply. Although public supply is unable to meet rapidly escalating demands, some continue to access the highly subsidized public supply while others must pay to buy water from private agencies. Public drinking water supply has become so unreliable in both quantity and quality that many households have to purchase bottled water (whose quality is also often questioned) for drinking. Rural water sources are being leased to private companies who then sell the water in tankers. What conditions have been maintained for harvesting these water sources is not clear. In most cases, protection of water sources and priority access to local people have not even figured in the calculation except for payment of royalties. For all practical purposes, these public resources are being privatized. A highly unsatisfactory situation with respect to the urban water issue is becoming increasingly obvious. In the past the focus has only been on developing big projects like Melamchi without looking at all the numerous decentralized watershed-based water sources that are being exploited by the private sector.

The second major problem is the pollution of existing water bodies in urban areas. The historic ponds found in many parts of the older towns of Kathmandu Valley have become disgusting eyesores of the urban landscape. Most of the public stone waterspouts—very important traditional water sources—are either completely dry or bring water mixed with sewage (Paudel 1996). A significant aspect of water pollution has been the worsening conditions of the Bagmati River, which runs through

Kathmandu Valley and receives a large part of the waste from the two cities of Patan and Kathmandu, as discussed in Chapter 8 of this volume.

Paudel (1996) points out that the decline in river quality has resulted in increasing incidents of diarrhea, typhoid, jaundice, cholera, and skin diseases among users, who have few alternatives. Livestock is also affected, but the most serious effect has been the loss of almost all the aquatic life of the river.

The Melamchi Project has been undertaken to meet the long-term needs of Kathmandu Valley. The project has been under construction for the past few years and is already embroiled in many conflicts (Siwakoti-Chinton 2003). Local people complain that the project has adversely affected many areas of livelihood and food security. It does not address the dry-season water needs of the people, and there are outstanding issues of compensation and resettlement.

Groundwater mining has been an important source of supply in Kathmandu Valley and other urban areas in the plains. The long-term implications of pumping excessive groundwater in the Valley have not been studied. Harvesting this resource requires substantial investment, and clearly the poor cannot afford it. With decreasing levels of groundwater, the cost of accessing it has also increased. At different places it is rich in mineral contents that may be harmful to health. Using it with poor treatment is a health hazard for many. The fact that it is not properly regulated or its exploitation properly guided is a major gap that needs to be corrected before a serious problem occurs (Pradhan 1999; CBS 2004).

National Debate on Water Projects

Water projects used to be considered simple and straightforward engineering decisions. Today water projects are being screened carefully for their economic, social, and environmental effects. Even those affected people who had been silent spectators in the past are taking leading roles in asserting their rights in project decision making and management, advocating for adequate compensation if affected adversely (Chintan undated).

Nepal is a country with substantial water resources and huge potential for developing them. While all agree about the untapped potential, there is increasing controversy about future development (Bandyopadhyay and Gyawali 1994; Dixit 1994; Pandey 1994). The position favored by the Government and private-sector developers is that large-scale projects offer multiple opportunities for flood control, irrigation development, and hydropower development. Many of these benefits accrue to downstream areas and urban centers, along with possibilities for export. The benefit streams are projected to be fairly substantial, although the costs of such projects are also extremely large—quite often impossible to meet without outside funding.

Global experience on dams and development has concluded that past projects have not been as economically, socially, or environmentally sound as they were originally made out to be (Dixit et al. 2005). In the context of mountain areas such as Nepal, large-scale projects (i) have high unit costs (Pandey 1994), (ii) have directly and indirectly displaced huge numbers of people and failed to provide adequate compensation (Dixit 1994), (iii) dams have experienced high levels of sedimentation and large-scale dams in mountains may be risky because of high seismic activity, and (iv) these dams have very often neglected to help the people in the project area itself (Bandyopadhyay and Gyawali 1994).

In large projects, the entire exercise of planning and implementation is not transparent and once the project starts moving ahead, it appears to be unaccountable to anyone (Chintan undated). Downstream areas and even countries are not willing to pay for the increased water available in lean seasons because of reservoirs (Pandey 1994). Much time has been wasted over big dams with few results.

Paranjapye (1994) had this to say in the case of the Arun 3 project: "a juggernaut that will inevitably distort, undermine and prevent the process of planning and decision making". He proposed the alternatives of going small, with a decentralized system, encouraging local entrepreneurs. There will be larger local benefit through lesser displacements and reduced construction periods and earlier flow of benefits (Pandey 1985). Even smaller systems can supply the electric grid.

Clearly the odds against large dams are increasing, but that model retains its advocates and on a case by case basis large dams may be warranted sometimes. The issues of scale are clearly relative based on what a country can afford and what is realistic in terms of socioeconomic and environmental conditions (Dixit et al. 2005). The most important implications of this development are that the debate has forced projects to be far more careful in considering many different parameters, including the voice of those who will be displaced. There is also an urgent need for greater transparency, and participation of all stakeholders.

Nepal–India Differences over Water Projects

Although agreements on water projects were signed to develop the Kosi (1954) and the Gandak (1959), and both projects were completed, these bilateral

Lakhpa Norbu Sherpa

J. Gabriel Campbell

Min Bajracharya

Brian Peniston

Sources and solutions of environmental conflict: clockwise from top left-collecting medicinal plants; community forest user group; poachers in Sagarmatha National Park; queuing for water

cooperative ventures provided neither dependable nor adequate supply of water to Nepal or India and have been unable to improve agricultural productivity (Dixit 1994, Gyawali and Dixit 1994). Another author points out that trust and understanding have been eroded, creating a major impediment to cooperative development (Kumar et al. 1994).

The most recent example of a project that has run into problems is the Mahakali Project, which has become a hot political issue in Nepal. Although there have been several rounds of negotiations, there are still numerous outstanding issues that need to be resolved before the project can move ahead (Swain 2002). India's unilateral construction of dams in border areas to prevent summer floods and to store water during the dry season has created problems on the Nepalese side. Every year some dam is controversial; recent cases include the Mahalisagar dyke and the Khurdolotan dyke. During summer both of these have inundated large areas in Nepal (The Himalayan Times 2003).

Urban Environment and Conflicts

Given the rapid increase in urban population, it is not difficult to imagine that intense competition for space and other resources will lead to conflicts. In cities around the world, conflicts over water, dumping sites, air quality, and noise levels are leading to litigation and outright violence (Matthew et al. 2004). In the early stages of urban development, there is a high tolerance for environmental problems, but with further growth a point is reached when awareness, and the ability to afford a cleaner environment, increases and urban renewal begins to take place.

Urbanization in Nepal is still among the lowest in the world, although it has been rising quite rapidly. In 2001, 12% of the population—roughly 3.2 million people (Sharma 2003)—were urban dwellers. However, the distribution is very skewed because five of the bigger centers with over 100,000 population had 39% of the total urban population and the remainder was distributed among 53 other centers. Increasing the size of an urban area gives it many advantages, but it also appears to bring many environmental problems and associated conflicts.

Kathmandu's notoriety as a polluted city has grown over the years and so have the conflicts. Because it is the capital city and the biggest urban center in the country, its experience provides a good idea of what can be expected overall if problems are not dealt with in their early stages. Some of the conflicts are related to certain types of industrial and development activities. Fortunately many of the problems have not sought violent solutions and people have instead opted to go to court. Some of these court cases and decisions are presented below as examples of the environmental conflicts facing urban areas. These cases have been taken from the collection of environmental cases put together by Pro Public (Sharma et al. 2000).

One of the earliest recorded cases of urban environmental conflict was in 1968/69 when a concerned citizen filed a case against the city authority's plans to construct stalls for shops around a public park in the heart of Kathmandu City which had a historic significance (Sharma et al. 2000). The case was dismissed but was reopened when the persistent individual took his grievance to the Royal Palace and succeeded in getting a Royal directive to the court to reconsider his case. However, the plaintiff died before the second hearing and the court stated that accordingly there was no need for a decision and dismissed the case, although in its earlier decisions the court had ruled that the construction had no personal impact on the individual.

Another case appeared in 1972/73 when an individual complained against his neighbor's activities to destroy a public pond next to his property for construction on the site (Sharma et al. 2000, pp.13-18). Again the court went through several rounds of deliberations. Dissatisfied with the court's first ruling, the complainant filed a petition to the Royal Palace and succeeded in obtaining a directive for reconsidering the case. The city also had an interest in the case, had formed a committee to look into the public significance of the pond, and had earlier recommended that the pond was indeed a very holy site with significant religious value for the local people. In its second deliberation the court reiterated this aspect of religious significance and ordered that the pond be preserved.

The next case, in Bhaktapur, may be the first of its kind in Nepal on air and noise pollution control. In 1978/79 a person complained about a factory's exhaust fumes, pointing out that it had adversely affected the health of the people living around the factory and that this had increased after the owner had illegally expanded the factory's capacity (Sharma et al. 2000). He also pointed out that the city authority and the department responsible for giving the license to the industry had neglected their duties by not looking into the expansion proposal carefully. The court considered the facts and gave a surprising decision that there was no evidence of damage to the person or the property of the complaining individual and dismissed the case. Pollution was a new subject and empirical evidence of the health impacts of deteriorating air quality was probably not

available at that time. The Supreme Court did not see a conflict between the polluter and the public, although the complaining individual was clearly ahead of his times.

The Godavari Marble Factory, located on the outskirts of Kathmandu Valley, was charged with polluting the air and water of the area and with emitting dust that was destroying the biodiversity of the forest. The court took the position that the complaining individuals were not directly affected by the activities of the factory and dismissed the case. It was resubmitted in 1992/93 and again in 1995/96. It is interesting that the court was becoming pro environment during this time. The Rio Summit in 1992 received global attention, and environmental issues were hot in every society around the globe. This probably had some role in changing the later rulings, which pointed out that environment was a concern of every citizen and could not be dismissed as in the earlier cases. The court directed the factory to install proper safeguards (Sharma et al. 2000).

The case of the pollution in the Bagmati River is similar. Although in this case no single offender existed, the court did identify numerous organizations as responsible for correcting the pollution of the river (Sharma et al. 2000). The court also directed the organizations concerned to protect historic monuments, keep proper records of the property of these monuments, stop construction of an unplanned road, establish a sewage treatment plant, and improve cremation grounds. All of these interventions were also to ensure that the maternity hospital was not adversely affected.

The changing position of the courts has been a most welcome development. Future cases are likely to be even more complex, with additional issues of compensation and related measures to right past wrongs. A persisting anomaly and a major source of conflict in countries like Nepal is the readiness of the Government to introduce environmental legislation without ensuring adequate supervision, monitoring, and implementation—which permits offenders to continue polluting the environment.

The Maoist Insurrection and the Environment

The Maoist insurrection is now close to nine years old and has affected all aspects of Nepali life including the environment. While only post-conflict evaluation can reveal the actual extent of changes caused by the conflict, there are scattered reports on different aspects of environmental changes that may be attributed to it. The conflict has directly damaged the environment in terms of destruction and damage to environment-related personnel, resources, infrastructure, and conditions. Furthermore, the environment has impacts on the conflict.

First let us look at the direct impacts. Based on a field review commissioned by the World Conservation Union (IUCN), the Nepal Forum of Environmental Journalists did a selected review of some areas of the conflict's impact on the environment (IUCN 2004). The review identified several points of impact.

(i) Deforestation is widespread and different sides blame each other. It should be noted that deforestation is not unique to the conflict. It has been an ongoing part of Nepali society. What part of the deforestation can be attributed to the conflict is difficult to ascertain.

(ii) Setting forests on fire has many impacts on wildlife. Again, this is not unique to the conflict and it is difficult to know what type of wildlife has been affected and how.

(iii) Poaching of wildlife has increased substantially. This is highly plausible with the reduction in security in the national parks. While the Maoists may not be poaching directly, they may be involving traditional poachers and benefiting from the trade, but there is no hard evidence.

(iv) Impact on drinking water supply either because of increased demand or because of damage to water supply systems has been reported by the local newspapers in a number of areas.

(v) There has been significant displacement of households from conflict-affected areas, primarily due to the difficulties of meeting the different demands of the Maoists.

(vi) There is an inability to access forest products because of fear of the Maoists who camp in the forest areas.

Another recent study (Murphy et al. 2004) has also identified some of the impacts of the conflict based on reports from newspapers, publications, and discussions with concerned people. Some of the major impacts reported are listed below.

(i) Destruction of park infrastructure in almost all the national parks, making these unusable. This has been reported by others (American Embassy 2005) when as many as 54 endangered one-horned rhinos were killed in two national parks but mostly in Chitwan National Park. The absence of protection in national parks is seen as the major reason behind this. In 2003, 50 people concerned with poaching were arrested and

further poaching has not been reported so far. During 2003 the officials also made a big catch of 32 tiger skins, 579 leopard skins, and 660 otter skins. Authorities have caught people with shatoosh skins. The origins of these materials are not yet established but it is widely speculated that Nepal has become a favorite spot for illegal trade in wildlife parts (Asia Rainforest Conservation News and Information 2000; World Environment Journalist Egroup 2002), and the reduced surveillance in this area could have motivated poachers and others to take advantage of the prevailing situation in Nepal.

(ii) Organizations working in conservation have had their work adversely affected either because of direct threats or because of the prevailing insecurity in rural areas. Many organizations have relocated their staff to the district headquarters or to Kathmandu.

(iii) Encroachment of park land has also been mentioned.

Some positive impacts have been reported. If timber smuggling has increased in some areas, it is reported to have been reduced in others. Similarly, in some areas people say that because they are afraid to go into the forests, the forest has recovered and some of the wildlife has returned. It is difficult to establish the precise nature of these changes as verification from the field is difficult.

Having reassigned security forces to conflict areas, the national parks are now more vulnerable to poachers, encroachers, and others who value the different resources of the parks. In some areas the security forces have reportedly cleared forests that were hiding grounds for Maoists (Hakahaki 2060 [2003]). At times of conflict, getting hard evidence is not easy, and causes and effects may be very complex. Only the future will provide a more firm basis for knowing the real impacts.

Many writers both from within and outside Nepal have identified the deteriorating physical environment as a major factor for the insurrection. Sharma argues that there is a strong ethnic dimension to this conflict and that ethnic groups are concentrated in relatively difficult environments (Sharma et al. 2000). Murshed and Gates (2003) point out that horizontal inequality across the regions of Nepal is a major factor behind the conflict. Bhurtel and Ali (2003) argue that the deteriorating environment with its combinations of factors such as fragile mountains, deforestation, soil erosion, decreasing land productivity, and high levels of population growth and poverty mixed with social factors of exclusion, discrimination, marginalization, and disempowerment of ethnic minorities produced a violent eruption that has now lasted for almost a decade.

It may also be noted that there has been an increase in the militarization and politicization of ethnicity in the northeast of India. According to Barbora (2004) this is due to the state's failure to deal with the changes brought about by radically different land use regimes. The Hill areas may be experiencing the inevitable involution. Authorities and indeed society may have neglected, overlooked, or suppressed many smaller implosions in the past which today have boiled over in the form of a violent conflict. The environment in these societies is both an important cause as well as a victim of the escalating conflict.

Conclusions

This review has provided an overview of the prevailing conflicts regarding natural resources utilization and some aspects of the rural and urban environment in Nepal. Conflicts appear to be fairly extensive regarding some natural resources like forests and water. In other areas such as the implications of urban development on natural resources and the environment, the future is worrying because of the weak nature of the institutional mechanisms available for resolving these problems.

What has been or can be the impact on ecosystems and the economy because of the unresolved conflicts? Some problems appear to have remained for so long that they look almost unsolvable. A major part of the problem is related strongly to the increasingly active role of the state in trying to regulate the harvesting of natural resources and taking on responsibilities for which it does not have adequate resources or capacity. The more surprising revelation is that the Government still has not recognized the continuing nature of conflicts in the use of natural resources and responds only in spurts when conflicts become too difficult to ignore. This is not to say that there has not been some positive action by the Government—the most significant has been the move to legitimize the role of user groups in the management of forest and water resources. However, there is still a long way to go because the Government is holding on to many areas of authority, which limits autonomy and initiative to resolve problems at the local level.

The next issue is related to the laws. A major cleanup is necessary here because the practice appears to be to simply carry on as in the past even as new laws are promulgated. This has not only

created confusion and hindered progress in many areas, it has served to retain the Government's monopoly, even when the spirit of the new laws indicates that this is not the intention.

Once environmental decisions are taken by the courts, the Government, and civil society, who should do the enforcement? Conflicts mean that one party is not going to change its position voluntarily unless under the threat of punitive action. This aspect has been most lacking in the history of natural resources management. The recommendations of one commission are simply reiterated by another, and the process has gone on ad infinitum in the case of resettlement, illegal settlers, and encroachment. A similar story is being enacted regarding the Supreme Court's decisions in environmental matters.

As a mountainous country with a beautiful but fragile environment, it is critical that Nepal manage its environment by using its natural resources in a sustainable manner. The prevalence of conflict in all the major natural resource areas suggests that governance has been ineffective and in some areas even harmful, especially when short-sighted policies and decisions promote wanton destruction of natural resources. Clearly the Government has a major responsibility to clean up its act regarding environment and conflict in Nepal.

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Chapter 12

Environment and Trade

Introduction

This chapter is not about trade or about the environment; it is about the increasing overlap between trade and environment where there are trade-related environmental issues and environment-related trade issues. Trade-related environment problems can be seen in the exports of natural resources such as forest products and the resulting deforestation that could impact a watershed and lead to serious environmental consequences for an area's people and biodiversity. Export industries may be using so much of scarce water resources that the increasing competition actually keeps people and ecosystems from accessing this resource. In addition there may be significant water and air pollution, as there is rarely only one environmental problem associated with any type of manufacturing industry.

Environment-related trade issues deal with environmental measures taken to control or regulate environmentally undesirable trade because of threats to human and plant life or to the overall environment. The World Trade Organization's (WTO) sanitary and phyto-sanitary measures are good examples of environment-related trade measures. There is a wide ranging discussion about many of these environment-related trade measures because developing countries are arguing that this is another form of protectionism being introduced by developed countries.

On the one hand we see a strong move towards liberalization, with countries like the People's Republic of China and India coming up as new economic powerhouses following their gradual liberalization, but there is also a strong push from developed countries to impose new restrictions and sanctions on trade related with environmental, social, labor, and even human rights issues. Some of the environmental standards have adversely affected exports from developing countries. Many issues remain unresolved. Over the next few years significant changes will occur in the areas of trade and environment relationships. To the extent that developing countries can benefit from environmentally friendly exports, trade will have a positive impact on the environment. However, experience shows that this need not always happen. Exports are being lost on environmental grounds, given the high costs of changing industry practices, which may not be possible in the short run. In such cases both the environment and the economy may suffer.

Nepal is a relatively small and new player in the field of environment and trade. This may be both good and bad for the country. It may be good because its small trade means current investments in dirty equipment, management practices, and labor skills may be altered relatively easily. It may be bad because as a poor country it has few options and limited resources to exercise any option fully. Nepal is already a member of the WTO, having agreed to play by its rules. Exports to the European Union (EU) and United States of America (US) are limited but extremely significant in terms of overall exports. These are also the main destinations with tough environmental standards that are getting more stringent every year and are also being rigorously enforced by these countries. In addition there are multilateral environmental agreements, many of which Nepal has ratified or signed. How successful Nepal will be in promoting its trade in the context of these developments only time can tell.

The challenges for this poor nation are formidable not only on account of the increasingly stringent standards abroad but more significantly on account of the terribly disorganized state of the domestic institutions responsible for promoting trade and improving the environment.

This chapter reviews Nepal's current situation regarding trade and environment. The next section outlines the ongoing discussion in the areas of trade, environment, and sustainable development. This is followed by a review of the different trade-related environmental obligations under multilateral environmental agreements, and then a review of the trade environmental agreements that Nepal has with the WTO and India, and the restrictions imposed by Nepal. The next part reviews Nepal's exports, imports, and trade with different regions of the world. As Nepal's trade is relatively small, any serious effort to increase it will mean understanding better

how other countries with substantially larger trade have been faring so far. This is briefly discussed in the following section. The chapter closes with some observations on the future implications for Nepal's trade and environment.

Trade, Environment, and Sustainable Development

Liberalization of Trade

The rationale for free trade is based on the principles of comparative advantage. Interregional trade benefits both partners, as each can gain from the other's comparative advantages and have access to cheaper goods, raw materials, and new ideas; market discipline can also be enhanced. Trade also brings in critical foreign exchange. Although the direct relationship of trade to economic growth is complex, throughout history countries open to trading have always enjoyed greater prosperity than those that have remained relatively isolated. In today's world, with increasing global inter-dependence, few countries can pursue completely isolationist policies.

Bhagwati (2001) points out that India has experienced healthy growth since 1991 after reversing past protectionist policies and excessive reliance on the public sector. With the opening of its economy, India benefited from a growing world economy and direct foreign investment, which was made possible by changing past policies regarding taxes, licensing, foreign exchange, and others. He further points out that it is easy to fall prey to notions that markets, globalization, and privatization reforms are not for the poor. Without denying the need for supplemental policies, growth-oriented policies such as free trade are seen as necessary for reducing poverty.

Commenting on the performance of the Bangladesh economy, Ahmed and Sattar (2004) point out that trade liberalization and economic deregulation have contributed to output growth and helped to reduce poverty, although this might not have been to the extent desired. Other findings are that greater reduction in poverty will require more focused and targeted programs in agriculture and rural non-farm sectors (Ahmed and Sattar 2004). The direct effects of liberalization have been positive, with overall manufacturing growing more rapidly than before the new policies. The textile sector, which is fairly labor intensive and employs many women, has been a major beneficiary. The fears of de-industrialization and import rush have proven to be unfounded.

Going back a little further, we find that even in developed countries, trade was liberated in stages. Tariffs on manufactured products were gradually lowered over a fairly long period through successive rounds of international trade negotiations (South Center 1996). Although current account convertibility was introduced in the 1950s, capital account convertibility has been relaxed very slowly and in some cases only recently. This has varied significantly from country to country. Liberalization in labor flows has been even slower.

Insofar as developing countries are concerned, the creation of the United Nations Conference on Trade and Development (UNCTAD) was significant because for the first time the General Agreement on Tariffs and Trade (GATT) accepted that industrialized countries would provide preferential access in their markets to goods from developing countries, while permitting developing countries to impose tariffs on products from the developed countries. However, with the establishment of the WTO, some of this has changed. Whenever liberalizing reforms have been sudden and imposed by multilateral lending agencies, countries have faced a crippling debt crisis. When reforms have been voluntary, gradual, and guided as in some Asian countries, the results have been encouraging (South Center 1996).

Environment and Trade Discussions

Trade and environment relationships have been discussed since the 1970s, but without concrete results. With the mounting evidence of environmental effects on all aspects of daily life, stronger voices were raised in various international forums. In 1982 the developed countries raised issues of health hazards from products already prohibited in their countries (WTO 2005). From 1982–1993 a series of health-related trade measures were introduced by the developed countries. These have been integrated into WTO rules and regulations. Trade discussions have proceeded almost parallel to discussions on sustainable development and multilateral environmental agreements where trade plays an important role. While there are many overlaps, WTO reiterates that it is not an environmental agency.

United Nations Environment Programme (UNEP) reviewed the experience of a number of developing countries on trade liberalization and environment and concluded that trade liberalization is good for trade but not for the environment, and that specific attention must be paid to the environment (UNEP 1999). If environmental factors are not recognized at the outset and included in the policy design, irreparable damage may occur. Full valuation of resources and full cost pricing of resources are essential. A judicious mix of market instruments and

standard setting is the most appropriate approach. Access to information, methods of gathering data, and techniques of integrated analysis need to be improved.

WTO and Environment

The issue of environment has been highly controversial in the past few years and is likely to remain so in the future. WTO's position on the environment is reflected by the principles guiding its Committee on Trade and Environment. These are: (i) WTO is not an environmental protection agency and its competence is limited to trade and to those aspects of environmental policies that are trade related and may have significant effects on WTO members' trade; (ii) The WTO agreements (including earlier agreement under GATT) already provide significant scope for countries to pursue non-discriminatory national environmental policies; (iii) Increased coordination and internal cooperation are necessary to address environmental concerns; and (iv) Secure market access opportunities are essential to help developing countries work towards sustainable development (Boyer 2001; WTO 2005).

WTO's overall position is that trade can be both good and bad for the environment, and experience shows cases of both. "Win-win" outcomes can be assured through well-designed policies in both the trade and environment fields.

Some argue that trade and environmental issues need to be reviewed in the context of sustainable development. Sustainable development emphasizes, among other things, environmentally sound and sustainable production practices and the capacity to fulfill the basic human needs of present and future generations. Trade plays a key role in promoting particular types of technology.

Trade has been strongly linked to inequalities, environmental degradation, and poverty (Khor 1996). A major task before sustainable development is to reform trade. Arguing that free trade is always good for the environment ignores the large number of environmental problems in the world today. Although the toxic intensity of emissions and pollution as a proportion of gross national product has declined in the developed countries, the absolute levels are still going up (Boyer 2001). Other concerns raised in the context of world trade include the following:

(i) Many non-trade issues such as environment, labor, social standards, and human rights, especially those within the areas of domestic policy and national decision making, have been included.

(ii) It is maintained that environmental measures have been imposed on developing countries through the threat of trade sanctions.

(iii) There is a need to recognize the wide differences in endowments; levels of pollution, waste, and absorptive capacity; production systems; and levels of development, when determining environmental standards.

UNEP (2003) under its Global Environment Outlook scenario analysis undertook an exercise to look into the future, using four scenarios to explore what the future could be depending on different policy approaches. These scenarios are "Market First", "Policy First", "Security First", and "Sustainability First". Market First is basically following the practices of the present industrialized world. Policy First makes a deliberate effort to give priority to environmental and social concerns. Security First gives priority to overcoming striking disparities where inequality and conflict prevail. Sustainability First introduces a new environment and development paradigm. Some of the results were as follows:

(i) Carbon dioxide and other greenhouse gases increase significantly in the next 30 years under Market First and Security First scenarios. Global emissions start reducing around 2030 under the Policy First scenario because of carbon tax and investments in non-fossil-fuel energy sources.

(ii) Biodiversity, however, continues to be under threat unless urban and infrastructure expansion and climate change can be effectively controlled.

(iii) The Market First scenario sees some decline in percentage of basic human needs met, but the absolute numbers increase. Under Policy First and Sustainability First scenarios, a targeting of hunger helps to reduce significantly the percentages and total numbers of people affected. The Security First scenario leads to a sharp increase.

(iv) The report points out that "the overriding need in policy development is for a balanced approach towards sustainable development. From the environment perspective this means bringing the environment from the margins to the heart of development."

Nepal—Trade, Environment, and Sustainable Development

Nepal's present development strategy is outlined in the Tenth Five-Year Plan (2002–2007) which is also the Poverty Reduction Strategy Programme. The program has four major thrusts:

(i) Broad-based and sustainable economic growth,
(ii) Improving the quality and availability of social and economic services,
(iii) Ensuring social and economic inclusion of poor and marginalized groups, and
(iv) Vigorously pursuing good governance.

Nepal has been moving strongly towards a liberalized economy. It has drastically reduced tariffs and removed licensing requirements for many imports. It has divested many public enterprises, relinquished its public-sector monopoly on imports of fertilizer, and removed the subsidy on some agricultural inputs. The economy was showing many healthy signs regarding growth, trade, and even government revenue until very recently. However, the country's widening conflict has slowed the economy and many critical indicators have shown discouraging signs during fiscal year (FY) 2004 (MOF 2004).

Although the environment has not figured among the high-priority overall policies, it gets mentioned in sectoral policies such as forestry, infrastructure, urban development, and a few others. However, even under the Poverty Reduction Strategy Programme, it is inconceivable that rural poverty can be addressed without considering the available local natural resources and their sustainable management. Improved management of land, water, and forest resources and their better distribution are fundamental for reducing poverty in rural areas, in addition to developing rural non-farm sectors. Important issues regarding governance of natural resources need to be urgently addressed in the context of poverty reduction.

In addition to these measures, different action plans like the National Biodiversity Strategy 2004, the Clean Production Measures Programme, and the Environment Sector Support Programme are trying to address the country's environmental issues.

Nepal and Multilateral Environmental Agreements

Nepal has ratified the following conventions relevant to trade:

(i) Plant Protection Agreement for the South-East Asia and Pacific Region 1956.
(ii) Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES) 1973.
(iii) Montreal Protocol on Substances that Deplete the Ozone Layer 1987 and its amendments.
(iv) Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and Disposal.
(v) Convention on Biological Diversity (CBD) 1992, and the Cartagena Protocol on Biosafety 2000.
(vi) United Nations Framework Convention on Climate Change 1992, and the Kyoto Protocol 1997 (accession).
(vii) International Tropical Timber Agreement 1994.

There are a few other agreements that Nepal has not signed at present, but may eventually because of the issues they address.

Each of the agreements is reviewed briefly below regarding trade implications.

The Plant Protection Agreement for the South East Asia and Pacific Region, 1956 or Asia Pacific Plant Protection Convention. The main objective of this agreement is to prevent the introduction into and spread of destructive plant diseases and pests within the South East Asia and Pacific Region. In Nepal various measures have been implemented such as the Plant Protection Act 1972 (2029 BS), Plant Protection Regulations 1975 (2031 BS), Forest Act Amendment 1993, and National Parks and Wildlife Conservation Act 1973. However, implementation has been very weak due to an open border, insufficient checkpoints, and inadequate laboratories and quarantine stations (Sapkota undated).

Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES) 1973. CITES has a number of articles relevant to trade. Article II deals with trade in endangered species and defines conditions under which trade may take place. Protected species are classified and listed in three appendices. Article III refers to species threatened with extinction. Trade in these species is subject to strict regulation and permitted only under exceptional circumstances. The general thrust is that trade should not be for commercial purposes and should not be harmful to the species. The Convention of Parties under CITES regularly reviews illicit trade problems and recommends suspension of trade with countries that fail to comply with CITES provisions. Trade suspension is recommended when there is (i) significant trade, and (ii) absence of domestic measures to enforce the provisions of conventions. More recently in the Convention of Parties 11 it was agreed that trade suspension recommendations would apply to countries that did not submit annual national reports as required by Article VIII (7) (a) for three consecutive years.

Nepal has implemented various acts, rules, and regulations including a ban on collection, use, sale, distribution, transportation, and export of two plants —*Cordyceps misirensis* (yarcha gumba) and *Orchis latefolia* (paunch ounle). Similarly, the Government has banned transportation, exports, and sale of khayar (*Acacia catechu*), chanp (*Michelia ehampaca*), and sal (*Shorea robusta*). However, experts consider the existing provisions and measures taken insufficient to fulfill the obligations under CITES (Sapkota undated).

Montreal Protocol on Substances that Deplete the Ozone Layer 1987 and its amendments. The main focus is on controlling the production and use of ozone-depleting substances (ODS). Articles focus on controlling imports and exports of all types of ODS and changing chlorofluorocarbon technologies to more ozone-friendly options. Support has been received for institutional strengthening and technical advice for reducing the use of ODS. Parties having difficulties meeting their obligations under the protocol have to notify the Member of Parties. Nearly 2,500 projects are being implemented in developing countries to shift to non-ODS substances. Nepal has agreed to reduce chlorofluorocarbon use at the rate of 3 tons per annum, phasing it out entirely by 2010. For halons being used by agriculture, hospitals, and fire brigades, it was agreed to reduce the amount annually and phase it out by 2040 (Mainali undated).

Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and Disposal. This convention is directed towards environmentally sound management of hazardous waste as it is moved from one country to another. Countries can ban the imports of such hazardous waste. Exports must have written consent of the importers. If an importing country lacks the capacity to manage hazardous substances, parties can stop their exports. No hazardous waste can be exported to Antarctica, and there are packaging, labeling, and transport requirements for hazardous waste. Limited support is provided for capacity building.

Convention on Biological Diversity 1992. The purpose of this convention is the conservation of biological diversity, promotion of sustainable use, and fair and equitable sharing of benefits arising from the use of genetic resources. Although it does not directly refer to trade measures, there are activities with trade implications. Those relate to preserving and maintaining knowledge, innovation, and practices of indigenous and local communities, use of biological diversity, and fair and equitable distribution of the use of genetic resources. Translating these into actual legislation and other procedures will need to clarify conditions of access, sustainable use, and benefit sharing of a country's biological resources.

Nepal has instituted various policies, legislation, and institutional measures to implement the provisions of the convention, and completed a National Biodiversity Strategy in 2002. However, there is an urgent need for updating the biodiversity database so that the changes can be better understood over time and endangered flora and fauna better monitored and protected. At present, little is known of the extent of trade in endangered flora.

Cartagena Protocol on Biosafety, 2000. This protocol seeks to ensure safe transfer, handling, and use of living modified organisms that may have adverse impacts on biological diversity and human health. It maintains that trade and environment should be mutually supportive, without compromising biosafety for humans and environment. This protocol does not seek to change the rights and obligations of a party under existing international agreements like the WTO. However, parties can take more protective actions than called for in the protocol. It specifies an Advanced Informed Agreement procedure that will hold in the international transboundary movement of living modified organisms. There are provisions for a biosafety clearinghouse that will focus on risk assessment in accordance with specified procedures and time periods. There are specific handling and transport requirements for living modified organisms.

United Nations Framework Convention on Climate Change 1992. The objective here is the stabilization of greenhouse gas concentrations in the atmosphere. It does not directly restrict trade, but actions related to reducing greenhouse gases could impact trade. It points out that actions taken to combat climate change should not be discriminatory to international trade. A Global Environment Facility (GEF) provides financial resources to help countries reduce greenhouse gases by adopting appropriate technologies.

Kyoto Protocol, 1997. This protocol to the United Nations Framework Convention on Climate Change seeks to reduce emission of carbon dioxide through enhancement of energy efficiency in all greenhouse-emitting sectors. It supports the use of economic and financial incentives for adopting energy efficient technologies. It introduces the concepts of clean development mechanisms and emissions trading.

Although progress is encouraging, much remains to be done. EU countries have ratified the Kyoto Protocol but the US has not. In the absence of Parliament, Nepal became a Party to the Protocol through a Royal ordinance in September 2005.

International Tropical Timber Agreement (ITTA), 1994. This Agreement seeks to promote international trade in tropical timber, the sustainable management of tropical forests, and development of tropical forest industries. Trade-related aspects deal with providing a forum for consultation on promoting non-discriminatory timber trade practices, helping countries to develop strategies for sustainable management of timber products (including exports), diversification of international trade in tropical timber on a sustainable and equitable basis, bringing greater transparency in the international timber market, and promoting information sharing on the international timber market. Nepal is a member of the Agreement and has been participating in its meetings.

Agreement for the implementation of the Provisions of the UN Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks (UN Fish Stocks Agreement 1995). This agreement seeks to ensure the long-term conservation and sustainable use of straddling fish stocks and highly migratory fish stocks by requiring coastal states and states fishing on the high seas to cooperate in implementing agreed measures. There are provisions to deter activities of fishing vessels that undermine the effectiveness of internationally agreed conservation measures. There are also provisions to help build the capacity of least developed countries and small island nations to work towards meeting the agreement's goals.

Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade 1998. The objective is to promote shared responsibility and cooperation in the international trade of certain hazardous chemicals to protect human health and the environment. It focuses on promoting environmentally sound use through information sharing in all aspects of such hazardous chemicals. Trade in certain listed chemicals should be on the basis of prior informed consent. Obligations of a party under any other existing international agreements are not changed by this agreement. There are also provisions for providing technical assistance to countries if requested.

Stockholm Convention on Persistent Organic Pollutants 2001. This convention aims to reduce or eliminate releases of persistent organic pollutants into the environment to protect human health and the environment from such harmful substances. The convention makes provisions to prohibit or eliminate the production, use, import, and export of the pollutants listed in Annex A (Elimination) and restricts the production and use of those listed in Annex B (Restriction). It calls for development of national plans to implement the agreement and also provides technical assistance.

WTO and Nepal

The WTO was established to promote the free flow of trade and to ensure that trading rules are clear-cut and observed by all members; there is an accepted mechanism within the WTO for settling all trade disputes. It follows from the negotiations undertaken over many years in the GATT. WTO is not an environmental agency. However, a few environmental issues are trade related in the sense that environmental barriers could be erected by countries to restrict trade and that trade could be damaging to the environment. Such issues are within the domain of the WTO if members decide to seek its assistance. Further details about WTO are available on the WTO web site (www.wto.org).

Nepal was not a member of GATT, which was started in 1947 following the Bretton Woods Conference of 1944, which established the International Monetary Fund and The World Bank, and discussed the need for an international trade organization. GATT's focus was on reducing tariffs and trade barriers for promoting multilateral trade. Between 1986 and 1994 global trade talks were pursued under the Uruguay Rounds, which resulted in establishment of the WTO on January 1, 1995. In May 1989 Nepal applied for membership in GATT, and on September 11, 2003 Nepal was invited to become a WTO member. The period in between involved submitting it's Memorandum on Foreign Trade to be circulated within GATT, followed by various rounds of extensive questions from GATT and answers by Nepal before WTO granted membership.

By joining the WTO, Nepal cannot be discriminated against by another WTO member and it has the option to use the WTO's dispute settlement procedure, but there are also many obligations. In the area of services, Nepal has made broad commitments in 11 service sectors. Regarding tariffs, Nepal has accepted average tariffs of 42% on agricultural products and around 24% on industrial

goods. Most imports will be within the duty range of 10–20%. Nepal agreed to progressively implement the Agreement on Customs Valuation in accordance with the action plan, and full implementation will start from January 1, 2007. Nepal will implement fully the provisions of the Agreement on Sanitary and Phyto-sanitary Measures by January 1, 2007. Nepal will prepare an action plan, to be implemented in stages after it adopts the Food Act and implementation of the Codex Alimentarium. It will establish and operationalize a single enquiry point. Nepal will progressively implement the agreement on Technical Barriers to Trade in accordance with an action plan and implement those provisions fully by January 1, 2007. Nepal has agreed to incorporate all the substantive provisions of the Trade-Related Intellectual Property Rights Agreement in its new Industrial Property (Protection) Act to be promulgated no later than January 1, 2006.

Nepal has not become a member of the International Union for the Protection of New Plant Varieties. Nepal seeks to adopt an effective sui generis system for the protection of plant varieties as provided under Article 27.3 (b). In answering questions about the benefits to Nepal from WTO membership, Shrestha (2004) points out that this will avoid the risks of non-membership, as well as prevent any unilateral decision by a trading partner against Nepal. He further points out that Nepal will need to amend or enact 40 laws, although WTO required compatibility only in customs valuation, technical barriers to trade, sanitary and phyto-sanitary measures, and intellectual property rights. This was to be achieved over a period of four years. Regarding questions of import surges affecting domestic products, he did not believe that this would occur. Regarding subsidy for some of the primary producing sectors, some level of subsidy was still possible and there were provisions to address the problems of the primary sector through investments in infrastructure, research, and human resources development. At present Nepal's protection levels are nowhere near the levels permitted by the WTO, so there is no question about WTO membership reducing subsidies to farmers.

Nepal–India Trade Treaty of 2002

India has been and will continue to be Nepal's most significant trading partner because of Nepal's landlocked position with India enclosing it on three sides. The new trade treaty is far more restrictive than the earlier one and is likely to create many uncertainties for Nepal. The most significant development has been that India has imposed quantitative restrictions on four items—vegetable ghee, acrylic yarn, copper oxide, and zinc oxide—based on rules of origin, quota allocation, and non-tariff barriers (NTCS 2003).

Nepal's Own Trade Restrictions

As a WTO member Nepal must inform WTO about any ban notifications coming into effect.

(i) Nepal has banned the following products from being exported (FNCCI 2004):
   (a) Articles of archaeological and religious importance;
   (b) Conserved wildlife and related articles: wild animals, musk, bile, and any part of wild animals, snake skin, lizard skin;
   (c) Drugs, marijuana, opium, hashish;
   (d) Metals and jewellery: valuable metals and jewelry (exceptions permitted);
   (e) Articles of industrial importance, explosive materials, and related materials used in the production of arms and ammunition;
   (f) Industrial raw materials: raw hides and skins (including dry salted), raw wool, all imported raw materials, parts and capital goods;
   (g) Other products: turmeric has been banned; and
   (h) Export to India: all goods imported from countries other than India.

(ii) Nepal has banned the following products from being imported (FNCCI 2004):
   (a) Products injurious to health: narcotic drugs; liquor containing more than 60% alcohol;
   (b) Arms and ammunition and explosives (except under license): materials used in production of arms and ammunition, guns and cartridges, caper without paper, arms, and other explosives;
   (c) Communications equipment (except under license);
   (d) Valuable metals (except under license);
   (e) Beef and beef products;
   (f) Plastic rags and recycled plastic goods;
   (g) 118 azo dyes harmful to the environment; and
   (h) Any other product designated by the Government.

Nepal's Changing Pattern of Trade and its Environmental Aspects

Current trade with India

In FY1966 Nepal's total trade was only NRs 1157.1 million, of which 98% was with India (Table 12.1). Exports amounted to only NRs 375.1 million or 33% of total trade. Ten years later in FY1976 exports to India dropped to 75% and imports from India declined to 62% while overall trade more than doubled to NRs 3,167.5 million. In FY1986 exports to India further dropped to 40% while imports from India decreased to 43% and overall trade increased almost four-fold to NRs 12,419.2 million. This pattern of change continued during the next decade, and in FY1996 exports to India were only 19%, and imports from India 33% of total trade, which had increased by almost seven times to NRs 94,335.6 million. However, on account of a highly favorable Nepal–India Trade Treaty in FY1997, exports to India continued to improve, increasing from 24% in FY1997 to 59% in FY2004. A similar pattern was seen in imports, which increased from 2% of total trade in FY1997 to about 41% in FY2004 (Table 12.1).

The structure of exports has undergone major changes in recent years, shifting to manufactured goods, although trade with India still consists mainly of primary products and some processed materials. The trade balance has persistently remained against Nepal's favor; trade deficit/gross domestic product (GDP) ratio was 14% in FY2002 (Table 12.2). The total trade/GDP ratio increased from 22% during the 1980s to 41% in the latter 1990s. The rapid increase in trade has been attributed largely to the trade liberalization policies pursued by the Government since the early 1990s. The International Monetary Fund Trade Restrictiveness Index for Nepal was 2, with scores of 1–4 indicating an open regime and scores of 7–10 indicating a restrictive regime (NDF 2003). Different trade-related ratios are shown in Table 12.2.

Table 12.3 shows the major types of exports to India in FY2003 and FY 2004. Vegetable ghee topped the list, followed by jute goods and jute-related items, textiles, forest products including herbs, agricultural products, and miscellaneous manufactured items. Toothpaste and soap accounted for over 80% of the latter. There has been a great deal of fluctuation in the items from year to year. For example, some items exported in one year (like Chyawanprash) do not show up in next year's trade. Decreases in export value have been seen in many items, including vegetable ghee and 26 other important exports, although the total value of export trade has registered an 18% increase. The increase has been due to items such as wheat flour, hessian sacking, cattle feed, hides and skin, polyester yarn, readymade garments, and a few other items. The largest increases were in toothpaste and readymade garments.

Table 12.4 shows the major imports from India for two fiscal years. There was an overall increase in import value of about 18%. Petroleum products were the single largest imported item followed by textiles, cement, medicines, vehicles and spare parts, and machinery and parts. There was a decrease in some 25 imports between FY2003 and FY2004. The major decreases were in textiles and cement. About 16 imports registered increases, the major ones being chemicals, vehicles and spare parts, machinery and parts, and petroleum products.

Current Trade with Overseas Countries

Nepal's overseas trade was only NRs 23 million in FY1966 but increased to NRs 66,254 million three decades later. Thereafter it registered an annual growth rate of 10% until FY2001, when it reached NRs 100,100 million. After this it declined significantly to almost the level of the 1980s. It increased slightly during FY2004 to NRs 78,969 million. In FY2004 the major overseas exports were readymade garments, followed by woolen carpets, woolen and pashmina shawls, and handicrafts. Other exports included hides and goat skins, tea, pulses, cardamom (large), sugar, silverware and jewelry, towels, Nepali paper and paper products, and wooden goods (Table 12.5). The top ten countries for Nepal's exports are shown in Table 12.6. India, the United States (US), and Germany are the major importers of Nepali exports with shares of 57%, 18%, and 6.6%, respectively, in FY2004. Table 12.7 shows the top ten countries that are sources of imports to Nepal. India, Singapore, and the People's Republic of China were the major suppliers of Nepal's imports with shares of 59%, 6.3%, and 3.9%, respectively, in FY2004.

Environmental Dimensions of Trade

Internal Trade

Although there has not been any reference to internal trade in this chapter so far, clearly in the context of environmental impacts, this cannot be neglected. The problem is that domestic trade, its growth and impact, and so on have not been studied to date. There are no records of any type regarding internal trade.

If we look at the national accounts, trade has been lumped together with restaurants and hotels, although the latter two will be fairly small compared with the value of domestic trade. This sector contributed 11.6% of GDP and was second only to

Table 12.1: Direction of Foreign Trade (NRs million)

Item	FY1966	FY1976	FY1986	FY1996	FY1997	FY1998
Export (FoB)	375.1	1,185.8	3,078.0	19,881.1	22,636.5	27,513.5
India	370.5 (98.8)	893.7 (75.4)	1,241.1 (40.3)	3,682.6 (18.5)	5,226.2 (23.5)	8,794.4 (32.0)
Other countries	4.6 (1.2)	292.1 (24.6)	1,836.9 (59.7)	16,198.5 (81.5)	17,410 (76.9)	18,719.1 (68.0)
Imports (CIF)	782	1,981.7	9,341.2	74,454.5	93,553.4	89,002.0
India	763.5 (97.6)	1,227.1 (61.9)	3,970.9 (42.5)	24,398.6 (32.8)	24,853.3 (26.6)	27,331.0 (30.7)
Other countries	18.5 (2.4)	75.6 (38.1)	537.03 (57.5)	50,055.9 (67.2)	68,700.1 (69.3)	61,670 (69.3)
Trade balance	-4,0619	-795.9	-6,263.2	-54,573.4	-7,016.9	-61,488.5
India	-393 (96.6)	-333.4 (41.9)	-2,729.8 (43.6)	-20,716.0 (38.0)	-19,627.1 (27.7)	-18,536.6 (30.1)
Other countries	-13.9 (3.4)	-462.5 (58.1)	-3,533.4 (56.4)	-33,857.4 (62.0)	-51,289.8 (72.3)	-42,951.9 (69.9)
Total volume of trade	1,157.1	3,167.5	12,419.2	94,335.6	116,189.9	116,515.5
India	1,134.0 (98.0)	2,120.8 (67.0)	5,212.0 (42.0)	28,081.2 (29.8)	30,079.5 (25.90	36,125.4 (31.0)
Other countries	23.1 (2.0)	1,046.7 (33.0)	7,207.2 (58.0)	6,625.4 (70.2)	86,110.4 (74.1)	80,390.1 (69.0)
Share exports/in total[a]	32.7	37.4	24.8	21.1	19.5	23.6
Share imports/i n total[a]	67.3	62.6	75.2	78.9	80.5	76.4
GDP (at factor cost / current price)				248,913	280,513	300,845

Item	FY1999	FY2000	FY2001	FY2002	FY2003	FY2004
Export (FoB)	35,676.3	49,822.7	55,654.1	46,944.8	49,930.6	52,723.7
India	12,530.7 (35.1)	21,220.7 (42.6)	26,030.2 (46.8)	27,956.2 (59.6)	26,430.0 (52.9)	31,244.3 (59.3)
Other countries	23,145.6 (64.9)	28,602.0 (57.4)	29,623.9 (53.2)	18,988.6 (40.4)	23,500.6 (47.1)	21,479.4 (40.7)
Imports (CIF)	87,523.3	108,504.9	115,687.2	107,389.0	124,352.1	139,142.3
India	32,119.7 (36.7)	39,660.1 (36.6)	45,211.0 (39.1)	56,622.1 (52.7)	70,924.2 (57.0)	81,651.9 (58.7)
Other countries	55,405.6 (63.3)	68,844.8 (63.4)	70,476.2 (60.9)	50,766.9 (47.3)	53,427.9 (43.0)	57,490.4 (41.3)
Trade balance	-51,849.0	-58,682.2	-60,033.1	-60,444.2	-74,421.5	-86,418.6
India	-19,589.4 (37.8)	-18,439.4 (31.4)	-19,180 (32)	-28,665.9 (47.4)	-44,494.2 (59.8)	-50,407.6 (58.3)
Other countries	32,260 (62.2)	-40,242.8 (68.6)	-40,852.3 (68)	-31,778.3 (52.6)	-29,927.3 (40.2)	36,011.0 (41.7)
Total volume of trade	123,201.6	158,327.6	171,341.3	154,333.8	174,282.7	191,866
India	44,650.4 (36.2)	60,880.8 (38.5)	71,241.2 (41.6)	84,578.3 (54.8)	97,354.2 (55.9)	112,896.2 (58.8)
Other countries	78,551.2 (63.8)	97,446.8 (61.5)	100,100.1 (58.4)	69,755.5 (45.2)	76,928.5 (44.1)	78,969.8 (41.2)
Share exports/in total[a]	29.0	31.5	32.5	30.4	28.6	27.5
Share imports/i n total[a]	71.0	68.5	67.5	69.6	71.4	72.5
GDP (at factor cost / current price)	342,036	379,488	410,789	422,301	454,935	494,882

CIF = cost insurance freight, FOB = freight on board, GDP = gross domestic product
Note: values in brackets indicate percentages; the fiscal year (FY) of the Government of Nepal ends on 15 July. Fiscal Year before a calendar year denotes the year in which the fiscal year ends, e.g. FY2002 ends on 15 July 2002.
Source: FNCCI (2004)

Table 12.2: Trade/ GDP Ratios

Indicator	FY1981–FY1985	FY1986–FY1990	FY1991–FY1995	FY1996–FY2000	FY2001–FY2002
Total trade/GDP ratio	21.9	23.7	33.6	40.7	38.9
Export/GDP ratio	4.9	5.3	9.0	10.1	12.3
Export growth rate (%)	23.6	14.4	31.6	24.5	17.1
Import/GDP ratio	17.0	18.4	24.6	30.6	26.6
Import growth rate (%)	17.2	18.9	28.4	11.7	16.4
Trade deficit/GDP ratio	12.1	13.1	15.7	20.5	14.3
Current account deficit/GDP ratio	3.0	6.2	6.2	4.5	2.7
Export/import ratio	29.2	28.8	36.8	33.7	46.3

GDP = gross domestic product
Source: NDF (2004)

Table 12.3: Selected Exports to India (value in NRs '000)

Commodity	FY2003 (2059/60)	FY2004 (2060/61)	% Change	Commodity	FY2003 (2059/60)	FY2004 (2060/61)	% Change
Pulses	880,400	575,000	(34.7)	Rosin	221,600	138,200	(37.6)
Ghee	54,600	36,600	(33.0)	Brooms	102,700	65,300	(36.4)
Herbs	111,900	79,100	(29.3)	Noodles	309,700	259,700	(16.1)
Ginger	315,400	263,500	(16.5)	Biscuits	25,100	15,500	(38.2)
Dried ginger	108,400	73,000	(32.7)	Marble slabs	28,600	36,900	29.0
Linseed	45,800	33,400	(27.1)	Cattle feed	405,900	544,100	34.0
Cotton seed	300	200	(33.3)	Barns	62,800	37,500	(40.3)
Fruits	2,400	700	(70.8)	Oil cakes	311,100	303,700	(2.4)
Vegetables	43,000	17,000	(60.5)	Hides and skin	248,500	332,300	33.7
Wheat flour	7,100	32,200	353.5	Toothpaste	1,002,800	1,478,800	47.5
Vegetable ghee	3,812,300	2,959,000	(22.4)	Polyester yarn	656,900	1,114,500	69.7
Jute goods	1,899,000	1,882,600	(0.9)	Readymade	399,200	626,200	56.9
Hessian	44,200	143,500	224.7	Handicraft goods	44,800	25,600	(42.9)
Sacking	855,900	1,056,500	23.4	Veneer sheets	3,800	5,100	34.2
Twine	998,900	682,600	(31.7)	Toilet soap	469,200	539,100	14.9
Live animals	62,500	40,400	(35.4)	Chyawanprash	525,900	0	0
Rice barn oil	210,000	194,700	(7.3)	Hajimola	217,200	289,900	33.5
Turpentine	24,700	15,700	(36.4)	Kachha	11,200	8,200	(26.8)
Cinnamon	4,700	6,300	34.0	Iron scrap	7,000	3,700	(47.1)
Cardamom	469,600	449,500	(4.3)	Bristle	2,100	500	(76.2)
Catechu	145,400	159,500	9.7	Others	12,986,900	18,460,700	42.1
Stone and sand	189,500	140,400	(25.9)	**Total**	**28,329,000**	**33,126,900**	

Note: Trade with India for FY2003 is revised, and is provisional for FY 2004.
Source: Trade Promotion Centre (2004)

agriculture in FY1995. In FY2004 its share was 10.4%; it declined to third position after agriculture and financial and real estate. There can be little doubt about its significant role in the economy, and something this big will undoubtedly have direct and indirect environmental effects (FNCCI 2004).

Nepal's main environmental problems are deforestation, loss of biodiversity, soil erosion, air and water pollution, and in some areas solid waste disposal. In selected areas one also encounters pesticide problems (Banskota 2005). In the history of Nepal, economic integration has moved at a slower pace than political integration primarily because transport and communications, so vital for the development of trade, have expanded relatively slowly. Even now there are parts of Nepal accessible only by air or on foot. However with increasing economic integration, interregional trade follows for the same reasons as international trade—relative comparative advantages. In Nepal the trade links between the Hills and the Terai have been very significant with the Terai providing firewood, timber, and many agricultural products to the Hills—especially to the ever-growing market of Kathmandu

Table 12.4: Selected Imports from India (Value in NRs '000)

Commodity	FY2003 (2059/60)	FY 2004 (2060/61)	% Change
Live animals	404,000	204,800	(49.3)
Textiles	4,186,100	3,176,900	(24.1)
Readymade garments	444,700	410,900	(7.6)
Raw cotton	91,400	89,300	(2.3)
Thread	1,105,800	985,500	(10.9)
Fruits	284,500	241,500	(15.1)
Vegetables	772,800	638,700	(17.4)
Milk products	508,800	427,100	(16.1)
Tea	39,500	36,000	(8.9)
Coffee	37,000	40,500	9.5
Cumin seed and pepper	199,300	197,800	(0.8)
Salt	713,300	607,300	(14.9)
Sugar	119,500	12,600	(89.5)
Rice	744,900	515,900	(30.7)
Pulses	539,300	598,500	11.0
Wheat	216,500	269,700	24.6
Tobacco	534,300	563,200	5.4
Chemicals	1,906,600	2,526,200	32.5
Enamel and other paints	111,200	121,500	9.3
Cement	2,934,700	2,118,700	(27.8)
Pipe and pipe fittings	128,400	123,100	(4.1)
Sanitary wares	126,700	121,700	(3.9)
Bitumen	54,300	168,900	211.0
Electrical equipment	997,500	1,065,500	6.8
Medicines	3,225,700	3,329,600	0.2
Writing and printing paper	431,200	404,400	(6.2)
Books and magazines	304,500	327,200	7.5
Cosmetic goods	409,700	406,000	(0.9)
Chemical fertilizers	183,500	562,700	206.6
Insecticides	145,800	136,100	(6.7)
Hand tools	67,900	57,900	(14.7)
Agri-equipment and parts	689,900	477,400	(30.8)
Vehicles and spare parts	3,857,800	4,923,900	27.6
Tires, tubes and flaps	252,200	242,800	(3.7)
Coal	695,400	775,300	11.5
Machinery and parts	2,571,800	3,262,600	26.9
Glass sheets and glassware	439,800	444,900	1.2
Radios, televisions, decks & parts	128,600	87,900	(31.6)
Shoes and sandals	87,700	67,600	(22.9)
Wire products	162,700	99,200	(39.0)
Others	21,257,300	30,617,300	44.0
Total without petroleum products	**52,112,600**	**61,484,600**	**18.0**
Petroleum products	18,811,600	20,167,300	7.2
Total	**70,924,200**	**81,651,900**	**15.1**

Note: Trade with India for FY 2003 is revised, and is provisional for FY2004.
Source: Trade Promotion Centre (2004)

Table 12.5: Percentage Share of Major Commodities in Nepal's Overseas Exports in FY2004 (2060/61) (NRs '000)

Commodity	Unit	Quantity	Value	Share in %
Readymade garments	pcs.	38,994,326	9,552,544	45.6
Woolen carpets	sq.m	1,648,918	5,461,301	26.1
Woolen and pashmina goods			1,473,675	7.0
Handicrafts			427,189	2.1
Sugar	t	9,250	404,165	1.9
Nepali paper & products			348,482	1.7
Silverware and jewelry			321,569	1.5
Pulses (lentils)	t	7,590	294,554	1.4
Hides and goatskin	sq.ft.	6,627,864	286,117	1.4
Towels			249,393	1.2
Cardamom (large)	t	1,111	228,963	1.1
Tea	t	1,002.2	106,897	0.5
Wooden goods			46,810	0.2
Other			1,740,002	8.3
Total			**20,941,661**	**100.0**

pcs = pieces, sq.ft. = square foot, sq.m = square meter, t = metric ton
Source: Trade Promotion Centre (2004)

Table 12.6: Major Trading Partners of Nepal : Exports (NRs '000)

Country	FY2002	FY2003	FY2004
India	27,956,200	26,430,000	31,244,300
United States	9,377,832	12,686,537	9,695,977
Germany	4,043,218	3,555,327	3,567,036
United Kingdom	808,751	1,070,737	1,677,085
Italy	566,557	530,869	589,370
France	473,472	453,961	581,762
Canada	305,978	383,651	546,403
Japan	492,833	474,247	525,601
Bangladesh	NR	411,335	421,308
Switzerland	382,823	NR	306,255
Portugal	NR	414,680	NR
Belgium	295,140	NR	NR
Subtotal	**44,702,804**	**46,411,344**	**49,155,097**
Other countries	2,683,984	3,599,778	5,261,517
Grand total	**47,386,788**	**50,011,122**	**54,416,614**

NR = not ranked in that year , only top ten countries are listed.
Source: Trade Promotion Centre (2004)

Table 12.7: Major Trading Partners of Nepal: Imports (NRs '000)

Country	FY2002	FY2003	FY2004
India	56,622,100	70,924,200	81,651,900
Singapore	7,346,919	9,039,197	8,698,647
China, People's Rep. of	4,315,803	4,760,342	5,433,815
Thailand	3,278,165	2,988,929	4,320,169
Malaysia	4,818,356	4,009,640	3,676,428
Indonesia	2,877,654	3,976,734	3,253,785
Korea, Republic of	2,500,974	3,380,348	3,080,644
Saudi Arabia	3,654,905	2,363,956	2,547,901
Germany	NR	2,278,356	1,977,896
Japan	NR	NR	1,690,396
Hong Kong	2,461,194	2,276,995	NR
United States	2,525,603	NR	NR
Sub total	**90,401,673**	**105,998,697**	**116,331,581**
Other countries	18,233,128	22,229,437	22,421,154
Grand Total	**108,634,801**	**128,228,134**	**138,752,735**

NR = not ranked in that year, only top ten countries are listed.
Note: Trade with India for FY2002 and 2003 are revised, and is provisional for FY2004.
Source: Trade Promotion Centre (2004)

Valley and its satellite towns. This large demand and the consequent trade have resulted in extensive deforestation of Terai forests, some in very critical ecosystems such as the Churia and the wetlands. Along with deforestation, the rich biodiversity of the Terai's subtropical forests has also diminished significantly. Roughly 4–5% of Nepal's exports to India consist of non-timber forest products and herbs, and there is concern about unsustainable harvesting of these products (Dhakal 2004, Tiwari et al. 2004). Another major impact of this deforestation has been the widespread flooding of the Terai plains causing extensive damage to crops and agricultural land, frequent changes in river courses, bank erosion, and debris deposits. Some of this occurs naturally, but the impact of anthropogenic factors has increased considerably (Banskota 2005) as a result of the rapid increases in population, deforestation, and expansion in agricultural land. The argument here is not to suggest that trade is bad. However, it does have environmental effects that should be carefully studied.

Trade involves transport, and in today's world motorized transport is using fossil fuel that adds to the carbon dioxide in the atmosphere and releases harmful gases. A recent study has highlighted some of the health effects in Kathmandu (CEN and ENPHO 2003). The time has come to better understand the environmental effects of increasing domestic trade and identify possible corrective measures.

International Trade

International trade has grown rapidly over the years with the trade/GDP ratio almost doubling in two decades. Today it stands at 40%. However, other smaller nations that depend on trade have ratios as high as 80% (NTCS 2003), suggesting that there are further potentials for expanding trade.

Nepal imports many environmentally sensitive products such as petroleum products, insecticides, and chemicals which are critical inputs into various production processes. These need to be carefully handled. Increasing use of fossil fuel is now seen as the main factor behind the deterioration of air quality in Kathmandu Valley (CEN 2003); this is already beginning to have many health

effects. Kathmandu Valley has a special environmental problem of temperature inversion, due to which air pollutants do not disperse very easily (Tuladhar 2003). Unleaded petrol was introduced in the country only recently, and there is concern about adulteration in the fuels available. If improving the quality of fossil fuel to minimize the presence of harmful substances is one aspect, there is also a need for the carriers to be environmentally friendly. Many of the vehicles are in a very poor state, and these are responsible for a lot of the pollution.

Another major problem is related to imports of pesticides and toxic and harmful substances. Their proper handling, use, storage, and transport are relatively unknown at present. Some studies on the use of pesticides have shown that few precautions have been taken, and that pesticides could become a public health hazard at any time (Pokharel 2003). While developed countries are introducing stringent regulations on many harmful and toxic chemicals, there is little monitoring of what is happening in Nepal. Nepal's weak monitoring and policing capacity could make it an attractive candidate for dumping harmful and chemical substances, whose toxicity may only become known after they are in the country. This is an important area and needs to be given serious attention in light of the long and highly porous open border with India.

What about environmentally sensitive exports? So far Nepal has been fortunate because no major export consignment has been rejected on environmental grounds. Environmental standards in the European Union (EU) and the US have become highly stringent and some aspects of this are discussed in the next section. Discussions with different experts[1], have identified several current and likely problems regarding exports to the EU:

(i) Exports of woolen carpets to Germany were required (voluntarily) to have ecolabels.
(ii) India imposed quarantine restrictions on ginger exports from Nepal, and exports were frequently stranded at the border because of the delay by India on pest risk analysis. Nepal could not provide the necessary data to India in time for the analysis. Now the quarantine problem on ginger has been solved.
(iii) Italy recently returned a shipment of Chywanprash because of the presence of toxic substances.
(iv) Some concerns have been expressed about pesticides and other prohibited residues in tea samples from Nepal.
(v) Nepal honey is not in the open list of the EU because of an insufficient residue monitoring plan and lack of legislation in Nepal to control the quality of honey. Further, the considerable production by indigenous honeybees is not recognized as "honey" under EU directives.

There may be other cases, but very little of this knowledge is in the public domain. Although the list is small so far, the lists of prohibited items in the US and the EU are very large, and care must be taken to ensure that farmers and producers from Nepal are well aware of these requirements. So far Nepal's exports have been limited and therefore the problems are also small. Some positive developments in this respect have been the award of Oeko-Tex 100 ecolabel certificates to five Nepali exporters to EU countries. There have also been efforts to promote cleaner production measures in industrial units, some of which are exporters (Adhikari 2004). Similarly the practice of organic farming and integrated pest management is also being encouraged. While these are positive signs, boosting Nepal's future exports will require major efforts to ensure that these are safe for the environment and humans, and meet the emerging standards in different parts of the world.

Trade and Environment-related Experience of Other Countries

Kirchbach (ITN 2001) highlights a number of interesting points regarding trade-related environmental barriers. He points out that of 4,917 products examined in world trade, only 24% did not face some kind of environment-related trade barrier in 2001. While the number of products is large, their value as a percentage of total trade is only 13%. Either exporters are focusing their attention on restriction of free markets or these are mostly low-value products of agricultural, forest, or mineral origin. About 90% of the barriers are concentrated in 44 products. The most common ones are food items, plants, bulbs and cut flowers, boneless bovine cuts, large automobiles, trucks, smaller automobiles, motor vehicle parts, coniferous timber, natural gas, footwear, medicine, telephones, and wildlife products. Apart from straight bans on imports, these barriers can take many forms—surcharges, internal taxes, advance payment requirements, transfer delays, quality control, prior authorization, quotas, obligations to return used products, and so on. Exports from less developed countries have been subjected most frequently to environment-related trade barriers.

What are the reasons for these barriers? Based on a review of the provisions in the WTO rules, as

[1]Dr. Krishna P. Pant, Senior Economist, Ministry of Agriculture and Cooperatives; Dr. Deb B. Shakya, Agro Enterprise Center, Federation of Nepalese Chambers of Commerce and Industry (FNCCI); Mr. Ratnakar Adhikari, Executive Director, South Asia Watch on Trade, Economics and Environment (SAWTEE)

well as other provisions in specific countries or regions, a number of reasons have been identified.

Precautionary Principle

Rio Principle 15 points out that where there are threats of serious or irreversible damage, lack of scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation (UN 1992). The principle was to protect the environment and public health even when scientific information was considered insufficient regarding the potential impact of a product or technology. It is clear that even the slightest suspicion can result in the use of this principle. Opponents of this argue that it can be easily used as a trade barrier. Many countries have already used this principle in the regulation of biotechnology and genetically modified foods, hazardous chemicals, and invasive and alien species.

Sanitary and Phyto-sanitary Measures

Sanitary and Phytosanitary Measures set out the basic rules for food safety and animal and plant health standards in international trade (WTO 1998). Countries can also set their own standards, which must be scientifically based and should not be arbitrary or discriminatory between countries where similar conditions prevail. Critics argue that because of its technical complexity, this has been very difficult to challenge and could be a very effective trade barrier in the future. Another point is that standards cannot be the same everywhere because of wide differences in living environments, and adjustments need to be made for this.

Technical Barriers to Trade

Technical barriers to trade deal with GATT rules governing the use of product standards. The Agreement gives countries the flexibility to take necessary measures to protect the environment, provided these are not discriminatory or trade restrictive (Jha 1999). The Agreement covers all technical regulations, voluntary standards, and procedures to ensure that these are met, except when these are sanitary and phyto-sanitary-related as defined by the Agreement. The two Agreements have many common elements.

Production and Process Methods

Products cannot be discriminated against based on the manner in which they were produced. For instance, timber produced by clear felling should not be discriminated from timber produced by sustainable forest management. However, some exceptions are permitted. One very prominent case regarded the dolphin-shrimp-turtle case brought to the WTO Panel by some member countries against the restrictions imposed by the US (Jha 1999).

Ecolabels

Ecolabels are a method of providing information to the consumer that the product is environmentally safe in its production and contents. This is now being increasingly used as a requirement for entering markets in the US, EU countries, and Japan. Mandatory labeling of genetically modified foods is required by EU, Japan, and Australia, while the US and Canada have complained that such labeling violates WTO rules (Chaturvedi and Nagpal 2003).

All the developed countries have developed their own ecolabels for textiles, and developing countries are encouraged to use these ecolabels if their products are to be competitive in these markets. The use of ecolabels is voluntary but becomes unavoidable if others are using it in their products. Ecolabels have raised many other issues regarding establishment of standards, certification, credibility of certifying authority, competent laboratories and their staff, and harmonization of standards among countries that have also been raised under sanitary and phyto-sanitary measures as well as technical barriers to trade (UNDP undated).

Subsidies

WTO agreements have attempted to lower subsidies across the board. While reducing subsidies on manufactured products has been accepted, subsidies in agriculture and fisheries have become a highly contentious issue in the WTO. Developing countries have been particularly concerned about the high level of subsidies provided to agriculture in the EU and the US (Bardhan 2001).

Investments

One objective of liberalization is to attract foreign capital. However if this is done without any environmental safeguards, it could be very damaging to the local environment as well as unfair to others who have instituted industrial environmental standards. One recent study (Busse 2004) indicated that there is no rush of industries to pollution havens. The only exception may be the iron and steel industry.

Services

There has been a move within WTO to pressure countries to liberalize service sectors such as

finance, insurance, education, media, transport, energy, health, water and sanitation, waste disposal, and others. The developed countries have many pollution abatement services and technologies to sell, and this move is seen by some people in developing countries as a way of promoting exports from the developed countries. While this may true for some of the services, it may not be applicable to others and a case by case evaluation is necessary.

Intellectual Property

This has been one of the most controversial and difficult provisions under the present WTO agreement. Developments in biotechnology have pushed the developed countries to press for stronger protection of intellectual property rights. Developing countries have lacked appropriate laws and the pressure is on to prepare needed rules and regulations. However, there are a number of serious concerns here such as (i) overlooking the collective nature of ownership of traditional knowledge developed over many generations and the possibility of foreclosing the entry of the public sector in the future, (ii) loss of biodiversity and adapted local varieties impoverishing the genetic pool, and (iii) promoting a very western, developed country friendly legal regime with respect to intellectual property rights. The developed countries have been somewhat unprepared for this reaction, as their agenda requires not only the development of related laws but also the capacity to enforce such policies (Boyer 2001, Chatuvedi 2003, Adhikari 2004).

Problems of Access to Information

Information regarding new environmental standards by the importing countries is often delayed, inadequate, distorted, and even non-existent at the time of the export. Exporters have been caught by surprise without sufficient time to prepare and respond appropriately. The technical standards are very complex in some cases, and these may not be understood. Even when understood the exporting firm may lack the capacity to do anything about it. This lack of knowledge and capacity to respond is a real problem for many of the small- and medium-sized exporters in many developing countries.

Heterogeneous Standards and Regulations

There appears to be a lack of uniformity of standards between countries for the same export. The cost of keeping up with the changes has been escalating. There is competition between organizations for certification and labeling for the same environmental standard. This may be helpful in reducing costs to some extent, but developing countries may face problems in choosing the acceptable ones. Some of the standards have been designed with the objective of creating new markets for cleaner production technologies or methods (Andrew et al. 2004). There are discussions about harmonization of standards, procedures for conformity assessments, and the possibility of establishing equivalence agreements. However this is a relatively new area and many aspects are still in their early stages of development.

Boyer (2001) points out that EU packaging and labeling standards including regulation on recycled content of paper are so high that most developing countries' exports will not be able to satisfy them. He maintains that although ecolabeling is voluntary it results in market segmentation; use of International Standards Organization (ISO) certification and expertise is very costly for most small exporters from developing countries.

Chaturvedi and Nagpal (2003), referring to India's experience with the EU, point out that permitted levels of additives and pesticides are very high, including emission standards for machines. He points that some EU importers have introduced "socially responsible trading" to reflect status of employees, working environment, facilities and the need to fulfill a new "code" for exporters. Similarly, the quarantine restrictions for fresh fruits and vegetables have become highly stringent. There is a ban on some types of antibiotics and chemicals. Any trace of DDT, aldrin, or heptachlor results in rejection of the export. Some dyes are banned in textiles and leather. There are restrictions on the levels of formaldehyde although there is controversy within the EU in this regard. Referring to Japan, Chaturvedi further points out that Japanese food sanitation laws prohibit imports of many citrus fruits. There is a zero tolerance law on insects, plant quarantine procedures are very lengthy, and preshipment inspection is possible but the cost is very high. Moving to the US, Chaturvedi (2003) provides some information on the interventions made by the United States Food and Drug Administration for detention of imports from South Asian countries. The major reasons for preventing entry of some exports were related to food additives, pesticide residues, and presence of heavy metals, moulds, microbiological contamination, decomposition, filth, low acid canned food, labeling, and a few others. The most important categories were filth (article appears to consist in whole or in part of filthy, putrid, or decomposed substances), violation of labeling requirements, and microbiological contamination (presence of bacteria such as salmonella and shigella).

Future Implications for Nepal

Increasing trade under stringent environmental conditions

There is little doubt about the increasing value of trade, both internally and externally, but trade cannot be a panacea for all problems of underdevelopment and how trade impacts different development goals needs to be studied continuously over time. Only then can appropriate policies be targeted to deal with specific problems. The Nepalese economy has benefited immensely from growing internal economic integration permitting specialization and trade between regions. It has also benefited from increasing external trade, which has made rapid strides in recent times. However, Nepal's trade is lopsided from the point of view of limited exports, few markets, and a rapidly widening trade gap. In addition, due to increasingly stringent environmental standards by developed countries, Nepal's exports face serious market access problems. There is also tough competition in some of the exports from other South Asian countries that have many advantages over Nepal.

Improving quality of trade

While international trade is important and for many commodities domestic markets may not provide comparable scales of demand, the poor quality of domestic trade is often reflected in international trade as well. Not much importance has been given to the quality of domestic trade. In fact many of the sanitary and phyto-sanitary conditions can be even more appalling in domestic markets. Increasing internal and international trade means greater quality control at home also.

Better understanding and awareness of WTO requirements

Nepal is a member of WTO and there is little point in debating this issue; now better understanding about what is expected from the traders in Nepal is needed. There are many ongoing discussion areas about this, some of them contentious. Nepal must do its homework and prepare for each discussion well in advance to negotiate in the country's best interests.

Improving technical standards and quality assurances

Shrestha and Shakya (2002) and Sharma and Karkee (2004) both emphasize this point. The technical requirements for quality assurance have now reached a level where many exporters not only lack the skills, expertise, and the infrastructure to meet them but do not really know what is required and who to turn to for help. Cost considerations are another set of critical issues. Experience in Bangladesh and India, particularly in the fishing industry, has revealed that compliance with quality standards not only requires substantial capital investment but can also entail very high annual operating expenses (Chaturvedi and Nagpal 2003).

The Nepal Bureau of Standards and Metrology is the national body for the development of Nepalese standards, adoption of international standards, providing quality assurance, certification, inspection, testing, accreditation, and harmonization procedures with the standards in Nepal's exporting regions. Nepal has some 600 standards, but only five related to safety and public health in export trade are mandatory—the remainder are voluntary (Shrestha and Shakya 2002). Standards acceptability abroad and their enforcement domestically will be a major challenge for export efforts in Nepal as all the major exporting countries are imposing increasingly stringent standards. The establishment of a South Asian Regional Standards Organization is a very positive step, and Nepal should work with others to make this organization well recognized and accepted internationally.

Compliance with Multilateral Environmental Agreements

Nepal has signed and ratified many different Multilateral Environmental Agreements. Some like CITES and the Convention on Biodiversity have well-defined focal points, but others need stronger action and monitoring. While multilateral environmental agreements related international organizations will not have the same effect as the WTO, environmental standards are expected to get much stiffer in the developed countries (Chaturvedi 2003), forcing countries like Nepal to take stronger action on the domestic front as well. Developing the institutional capacity and resources to move ahead on the different multilateral environmental agreements needs stronger attention.

Trade-related Intellectual Property Rights

The five-year period allowed for countries like Nepal to introduce legislation and other measures to meet the provisions of Trade-related Intellectual Property Rights (TRIPS) is already at hand. Nepal has only recently announced new laws regarding patents, copyrights, and similar. However, the broader implications of this agreement are still hotly debated both nationally and internationally (Boyer 2001,

Chaturvedi 2003, Adhikari 2004). The long-term impacts on national biodiversity, genetic pool, local food security, and protection of local innovation and traditional knowledge are still being discussed. With the collapse of American leadership on international environmental issues, Europe now leads in promoting new environmental standards (Boyer 2001) and it is not clear how this will proceed. Adequate capacity and resources for research, analysis, information, local registration, and maintaining a local registry are important practical aspects for the future. This subject is still developing, and Nepal must do a significant amount of homework as it shares a common endowment and heritage in genetic resources, medical tradition, and agricultural practices with many South Asian countries.

Trade Environment Surveillance

We know very little about the complex relationship between trade and environment. Interest in this subject grew only after the WTO agreement, which made it necessary to improve understanding of the technical aspects of trade and environment. Ignorance in this respect can be very costly in terms of the loss of export markets. Understanding domestic trade and its environmental aspects also needs to be significantly improved. In the long run the need to improve domestic standards is very apparent, especially regarding agricultural products. Nepal is a signatory to many different types of trading regimes—bilateral, regional, and international. It is not yet clear how each of these arrangements is serving the interests of the nation and what impact each has on the environment. Unless trade and environment are closely monitored in their different settings, our capacity to negotiate better economic and environmental deals may be severely compromised in the future.

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Chapter 13

Environmental Information, Analysis, and Integration

Introduction

Decision-making on complex issues related to the environment and natural resources must be based on accurate data. The synthesis and analysis of basic environmental data yields the information that is the precondition for developing policy framework, policy design, and the plans and programs for environmental and natural resource management. Concern for environmental issues in Nepal has increased in recent years. As the population at large becomes sensitized to environmental issues, there is a growing interest in analytical data and indicators of the state of the environment. The demand for environmental information is escalating, and governments and civil society stakeholders have been the driving forces on both the supply and the demand sides. Good, reliable data on Nepal are recognized as a fundamental tool needed for development. Developing and using information and knowledge are therefore essential parts of environmental planning and management from local to national levels. The use of such information leads to greater transparency and better governance, and hence plays a crucial role in environmental management. It is the foundation upon which many analytical and decision-making processes are based, which in turn are the precursors for effective actions on the ground.

Although over the years considerable environmental data and information have been compiled by various institutions, aid projects, and individual researchers working on different projects and programs, they have been difficult to access. Data appearing in isolated reports are often dispersed, heterogeneous, and inaccessible; more often than not, they are insufficiently relevant in terms of continuity and reliability. Without an appropriate framework and mechanisms for data sharing, time and resources are wasted in duplicating efforts for data collection and management. Public and private environmental institutions and bodies in Nepal have accumulated environmental data and information on natural resources and environmental conditions. These databases lack a centralized data pool and unified standards. There is no national database integrating all the sectoral data, nor are there any data linkages that would allow sharing of the existing information.

Role of Environmental Information in Decision Making

Determining the need for environmental information is perhaps the first step towards assessing environmental conditions at local, regional, and national levels. Efforts to improve environmental conditions are based on the assumption that rational environmental planning and management results from informed decision making. Environmental information for decision making gained special attention following the Rio Earth Summit in 1992 and was further emphasized at the World Summit on Sustainable Development in 2002. The summit underlined the importance of improved availability of information on all aspects of environment and development as well as the need for improved collection and presentation of data and information for decision making. Goal 7—environmental sustainability—of the United Nations' Millennium Development Goals specifies key targets and indicators, and highlights the need to promote and use environmental data and information to tackle and monitor pressing environmental problems. Some of the targets and indicators related to Goal 7 are shown below. (More details on the Goals are provided in the Annex at the end of this book).

Target 9: Integrate the Principles of Sustainable Development into Countries' Policies and Programs and Reverse the Loss of Environmental Resources.

Indicators:

- Proportion of land area covered by forest
- Land area protected to maintain biological diversity

- Gross domestic product per unit energy use
- Carbon dioxide emission per capita

Target 10: Halve by 2015 the Proportion of People without Sustainable Access to Safe Drinking Water.

Indicator:

- Proportion of population with sustainable access to improved water sources

Target 11: Significantly Improve the Lives of at least 100 million Slum Dwellers by 2020.

Indicators:

- Proportion of people with access to improved sanitation
- Proportion of people with access to secure land tenure

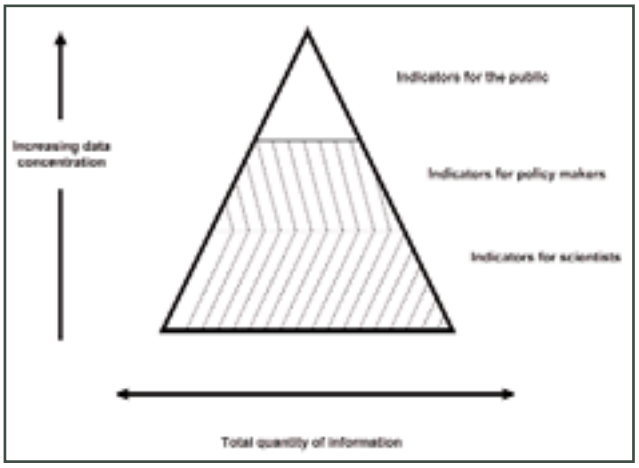
Coherent and compatible baseline data and data systems must be in place to derive the indicators described above. A United Nations Development Programme report by the Nepal Country Team in 2002 shows that Nepal's progress in meeting MDG Goal 7 has been poor and indicates that lack of data is part of the problem.

Importance of Environmental Indicators

Indicators need to be based on primary data which are the foundation for scientific analysis and decision making. An index is a composite of several indicators. Combining relevant indicators from the vast array of environmental data into a composite index reveals the evidence more convincingly than individual indicators would. Environmental indicators represent a powerful tool for communicating synoptic information on the environment to decision makers and the public. Indicators represent a bridge between the wealth of detailed information and the need for interpreted information. Environmental indicators facilitate better understanding of environmental trends and conditions at multiple levels of users—the general public, researchers and scientists, and policymakers (Figure 13.1). The packaging of environmental data into indicators will help to simplify complex issues and set precise goals, and monitor progress towards those goals.

Environmental indicators are not easy to formulate and their development is the subject of much national and international research (ICSU 2002). Environmental indicators are relatively underdeveloped compared with economic and social indicators, and there is no widely used composite index that captures the progress of environmental sustainability, similar to gross national product for economic development or the human development index.

Figure 13.1: Relationships among Indicators, Data, and Information to Meet Users' Needs



Source: After Braat, in Kurik and Verbruggen (1991)

Environmental Information Database Framework

Access to multisectoral environmental databases at multiple levels is the key to environmental assessment and monitoring. An environmental information database should integrate information from socioeconomic and biophysical sources, natural disasters, and polices and institutions. The United Nations Environment Programme (UNEP) has been advocating a framework environmental database for state of the environment reporting at the national level (Rump 1996). Embracing such a framework at the national level will help Nepal deal with environmental information (see Figure 13.2).

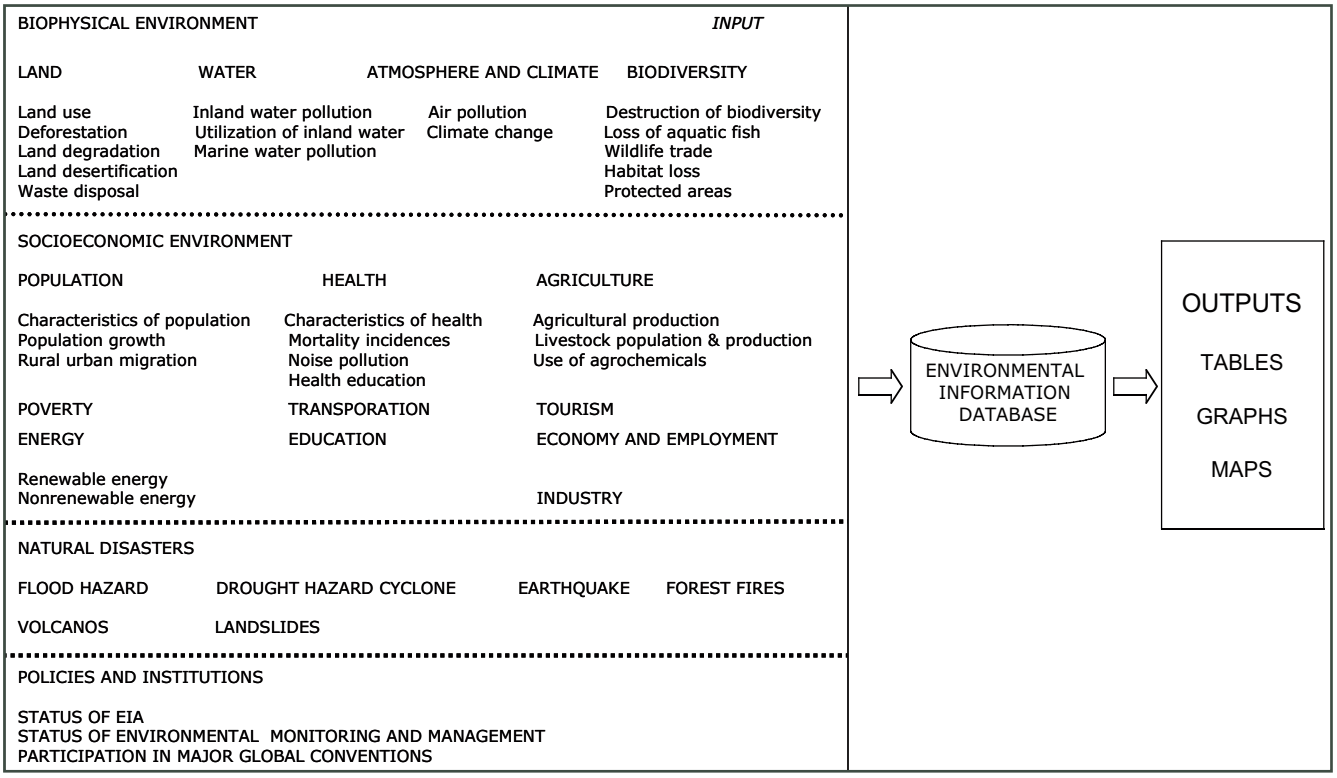
Issues Related to Environmental Information

Needs for environmental data and information are determined by specific environmental problems. Some critical questions regarding environmental data and information are:

(i) What are the pressing environmental problems?
(ii) What are the data needs?
(iii) What are the data gaps?
(iv) What are the institutional mechanisms to support the data and information?

Environmental data and information are multidisciplinary and integrative in nature, measuring human activities and natural events that affect the environment. There needs to be a

Figure 13.2: Framework for an Environmental Information Database



Source: UNEP/EAP-AP—State of the Environment Data Collection and Reporting Training for South Asia (unpublished).

continuous process to survey and monitor both quantitative and qualitative assessment of the resources base or environmental conditions. Specific environmental problems require assessment of existing data structure and identification of data gaps. Proper institutional mechanisms allow sharing of data and information and will fill the data gaps. A concept of "information infrastructure" is emerging in which information is seen as infrastructure like telecommunications or road infrastructure. Information infrastructure related to the environment can be seen as a broad policy, technical, financial, and institutional framework to promote and use environmental information. An information infrastructure on the environment will be the key to managing environmental problems. Such an information infrastructure on environment will facilitate integrating environmental concerns into economic development, tracking environmental changes and managing the environment, and promoting environmental awareness to the public.

Core Environmental Information

Almost all environmental problems share common information needs. These include basic descriptions of such things as topography, land use/land cover, infrastructure, and demography (human activity) that are common information denominators (UNEP and UNDP 1994). Such details can be considered the core environmental information that will facilitate better understanding within the context of the environmental problem (local, regional, and national) in its fullest sense. The specific type of environmental and natural resources information, however, will be dictated by the nature of the development interventions for which it is designed.

Development of core environmental datasets is often labor and technology intensive, and they are expensive to produce and update (UNEP and UNDP 1994). These core datasets provide a wide variety of uses specific to a given location; for instance, land use information is needed to address many environmental problems, but often no single use can justify the cost of development. Focusing on environmental assessment and sustainable development strategies, a broad-based symposium organized by UNEP and UNDP identified ten high-priority core environmental datasets that are central to many types of studies related to environmental assessment. These are: land use and cover, demographics, hydrology, infrastructure, climatology, topography, economy, soils, air quality, and water quality.

In Nepal, many different government agencies have mandates to generate and maintain core information, but the availability of information varies from theme to theme and data gaps persist.

Time Series Information

Generally two types of information are needed: the first is the baseline condition and the second is monitoring data to determine changes from baseline conditions. Developing monitoring networks often requires considerable investment in infrastructure; for example, investments in monitoring instruments or computer networks. For a developing country like Nepal, such investments are difficult and their use needs to be carefully evaluated in terms of costs and benefits in relation to policy objectives and programs. They should provide reliable, harmonized, and comparable environmental information for monitoring purposes.

In Nepal, monitoring information is often hard to obtain and difficult to compile due to lack of systematic data collection and monitoring systems. The monitoring of natural resources is particularly important, since that sector makes major contributions to the economy. Other environmental problems requiring monitoring include air quality in Kathmandu Valley and other major urban centers. This problem has been aggravated by heavy migration of people to urban centers due to the prevailing insurgency, although exact figures are unavailable.

Information Scale

Environmental planning and management are often influenced by particular geographic conditions and require spatial (map) information on natural resources, including major hydrology, topography, soil characteristics, and human activities. Scale of information suggests the amount of generalization that has taken place in compiling a map. The scale of maps is a critical but often overlooked factor for environmental assessment and monitoring. In Nepal, most maps are at different scales and have different coordinate systems, making it difficult to make overlays and integrate them into a common geographic information system (GIS) platform (Shrestha and Pradhan 1999). Data related to environmental problems requiring large-scale maps are unavailable or difficult to compile. Satellite technology (remote sensing imagery) is an alternative source for such information, but often associated with high costs, and its uses are limited due to lack of adequate technical expertise.

Institutional issues

Because resources and environmental information tends to be sector specific, institutional considerations surround information collection, processing, and dissemination. Because baseline data is commonly unavailable, database development is often carried out on a project basis with little focus on the generic uses of the data, leading to duplication of effort and data redundancy (Shrestha and Pradhan 1999). Seemingly comparable data generated by different agencies may in practice be incompatible as a result of differences in data format, reporting schedules, or the ultimate purpose for which the data were collected. Further, due to poor understanding of the processes involved and weak technical capabilities, datasets are often of low quality and lack standards. Little attention is paid to sharing data. An institutional mechanism is needed to encourage coherence while allowing for participation by a variety of institutions involved in environmental issues, taking into account their own specific needs and the need for a national vision. This institutional mechanism should aim for cost-effectiveness in funding and allocation of resources, and for policy relevance of the information. Such an institutional mechanism is yet to be seen in Nepal, though there is increasing awareness among professionals and scientists of the need for it.

Data Quality

Since baseline data will likely be used by many users, they must be of the highest quality. Sensitivity testing should be carried out, and each ministry and agency should reassess data quality standards and the data's ability to address their purpose. Generally, quality assessment procedures are weak in Nepal (ICIMOD and UNEP 2001) and the user communities must make do with the information that is available.

Data Standards and Metadata

Data standards ensure the quality of data and effective data interchange. No comprehensive environmental data standards have been developed in Nepal except for some specific application domains (ICIMOD and UNEP 2001).

Metadata is a process of documenting existing databases that provides information about data for access and use by the user community. Metadata is intended to provide as much information as possible about the data, its history, use, quality, and other associated information to the users. Such documentation of data or creation of a metadatabase has not been done in Nepal due to lack of know-how and standards, which will make future use of data difficult.

Status of Environmental Data and Information in Nepal

There is a need for a strong information base on all aspects of Nepal's environment and natural resources; this must be collected systematically from

decentralized multisectoral environmental agencies or institutions, analyzed, and presented in a timely manner. In Nepal, environmental data and information are collected by many sectoral agencies, and tend to remain with the agencies that generated them. As explained and illustrated in previous chapters of this book, a wide variety of sources are used for data collection. Although access to environmental information among government institutions is theoretically unrestricted, there is no clear, established mechanism to promote access to and circulation of environmental information. In practice, various publications and reports circulate among the agencies, but each agency tends to manage its own data sources and publications without much coordination or exchange of information about what is produced. As a result, needed information cannot be compiled quickly for multisectoral analysis of environmental issues. The following section highlights the status of environmental data and information in Nepal.

Data from the State of the Environment Nepal

The State of the Environment Nepal study was undertaken jointly by the Ministry of Population and Environment (MOPE), UNEP, and the International Center for Integrated Mountain Develoment (ICIMOD) in 1999 as part of an environmental assessment of Nepal and to contribute to UNEP's Global Environment Outlook initiative. The report (UNEP 2001) highlighted the major environmental issues of Nepal in five categories: forest depletion, soil degradation, air pollution, water quality, and solid waste management. The study aimed to set in motion a data collection and updating mechanism and process to support regular state of the environment reporting.

The study quoted 64 different sources identified during its efforts to compile information and derive indicators. Major sources of data were annual reports of the ministries and departments concerned, reports of the Central Bureau of Statistics (CBS), papers published in national and international journals, unpublished official records, and informal discussions with the experts and heads of the organizations and departments. Table 13.1a,b summarizes the different types of datasets collected for the report and the sources from which they were obtained.

Data on Environmental Impact Assessment

Performance of environmental impact assessments (EIA) was initiated in Nepal in the mid-1980s. Attempts towards institutionalizing EIAs include the National EIA Guidelines 1993 and EIA Guidelines for Forestry and Industry Sectors 1995. EIA guidelines for other sectors such as water resources, roads, mining, and urban development have been drafted. Integration of EIA through legal measures has also been initiated through the Environment Protection Act 1996 and Environment Protection Regulations 1997 (amended 1999). The Nepal State of the Environment study listed 44 different nongovernment organizations (NGOs) and 20 different consulting firms used to undertake different EIAs in Nepal. Many of these EIAs depend on secondary sources of information and in some cases primary data collection. EIAs are mostly carried out independent of each other and there is very little sharing of data and information and lessons learned.

Environmental Statistics

Besides collecting and processing social and economic data, CBS also collects and publishes data related to agriculture, fisheries, and forestry, and the environment. CBS regularly compiles and publishes environment statistics for Nepal prepared under the Framework for the Development of Environment Statistics (CBS 2004). The statistics relate to flora and fauna, atmosphere, water and sanitation, land and soil, and human settlement.

Under the framework, CBS relates these components to social and economic activities; natural events; environmental impacts of activities and events; response to environmental impacts; and inventories, stocks, and background conditions.

Data Collected by Government Organizations and Others

The Ministry of Agriculture and Cooperatives has an Agricultural Statistics Division that regularly publishes comprehensive statistical information on agriculture and related variables in its publication Statistical Information on Nepalese Agriculture (ADB 2004). The data released are advance estimates of district statistics on cereal crops, cash crops, pulses, livestock, poultry, fishery, and horticulture. Its statistical functions are limited to producing forecast data of crop area, agricultural production, and other agricultural statistics. CBS also carries out an agricultural census, and the differences between CBS and the Ministry of Agriculture and Cooperatives data must be evaluated and reconciled. Despite extensive data collection, there are considerable gaps in national estimates in terms of sources, desired frequency, and desired level of geographic disaggregation.

The Ministry of Forest and Soil Conservation compiles statistics related to forest and the environ-

Table 13.1a: Different Datasets Collected for the Nepal State of the Environment Report

Topic	Sources (Table 13.1b)	Topic	Sources (Table 13.1b)
Land: Deforestation	18, 10, 5, 43, 4, 23	Poverty	30, 4, 44, 41, 16, 37, 31
Land: Land Degradation	45, 18, 21, 5, 7, 23	Health	18, 4, 41, 2, 6, 45, 17, 13, 36, 31
Land: Land Desertification	18, 2, 5, 25, 45	Industry	4, 14
Land: Land Use	18, 2, 5, 14, 30, 12,	Agriculture	2, 18, 4, 19, 35
Land: Waste Disposal	18, 45, 4, 11	Tourism—International/Internal	18, 4, 32
Water: Inland Water Pollution	45, 38, 20	Transportation	18, 4, 45, 15
Water: Utilization of Inland Water	9, 18, 2, 43, 9, 45, 33, 34	Energy	4, 43, 18
Atmosphere and Climate: Air Pollution	45, 43, 18, 25, 22, 9, 15	Natural Disaster	18, 21
Atmosphere and Climate: Climate Change	9	Economy and Employment	18, 4, 30
Biodiversity	18, 7, 45	Policies and Institutions	24, 29,
Biodiversity: Loss of Aquatic fish	2, 18, 27, 4, 45	Policies and Institutions: Status of EIA	7
Biodiversity: Wild Life Trade	4, 15, 45	Policies and Institutions	
Biodiversity: Habitat	26, 7, 5	Signatories in Major Global Conventions	
Biodiversity: Protected Areas	28, 18, 45	Emerging Environmental Issues	
Population	18, 7, 36, 42, 40, 4, 1		
Education	18, 3, 4, 42, 41, 39, 40, 6, 30		

EIA = environmental impact assessment
Source: ICIMOD and UNEP (2001)

Table 13.1b: Key to Dataset Sources

Number	Source	Number	Source
1.	Ministry of Local Development	24.	Krishna Engineering Consultant
2.	Ministry of Agriculture	25.	Kathmandu Valley Vehicular Emission Control Programme
3.	Ministry of Education and Culture	26.	Land Resources Mapping Project
4.	Ministry of Finance	27.	National Account of Nepal 1998 CBS/HMG:35 pond+river
5.	Ministry of Forest and Soil Conservation	28.	National Biodiversity Action Plan HMG
6.	Ministry of Health	29.	Nepal Bureau of Standards and Metrology
7.	Ministry of Population and Environment	30.	National Planning Commission
8.	Ministry of Water Resources	31.	Nepal Rastra Bank
9.	Department of Hydrology and Meteorology	32.	Nepal Tourism Board
10.	Department of National Parks and Wild Life Conservation	33.	Nepal Water Supply Corporation
11.	Department of Agriculture	34.	People and Resource Dynamics Watershed Project
12.	Department of Forest	35.	Pesticide data from records
13.	Department of Health	36.	REGHED, Health Statistics of Nepal
14.	Department of Mines and Geology	37.	Rural Water Supply and Sanitation Project
15.	Department of Transport Management	38.	SMEC, Stanley International Ltd.
16.	Department of Water Supply and Sewerage	39.	Tribhuwan University
17.	Bir Hospital	40.	United Nations Environment Programme
18.	Central Bureau of Statistics	41.	United Nations Development Programme
19.	Cotton Development Board	42.	World Bank
20.	CEMAT	43.	Water and Energy Commission Secretariat
21.	Disaster Prevention Technical Center	44.	World Health Organization
22.	Environment and Public Health Organisation	45.	Individuals
23.	International Centre for Integrated Mountain Development		

Source: ICIMOD and UNEP (2001)

ment. The data are collected regularly from district and regional forestry offices through observation, total counting, and measurement, and the disaggregation is district, regional, and ecological. The forest resources inventory is based on standardized statistical methods, and sample errors, standard errors, and variation coefficients are computed. An Asian Development Bank (ADB) technical assistance report (ADB 2004) recommends that MOFSC strengthen its capability in coordinating the production of important statistics on forestry and the environment to be able to fill the current data gaps.

The CBS and the Department of Health Services of the Ministry of Health are the two major sources of health and environment related statistics. The Department of Health Services has an integrated health management information system that aims to encourage bottom-up planning from community level to national level. About 400 indicators are collected every month and about 100 derived from different reports. The indicators monitored concern child health, reproductive health (safe motherhood and family planning), and disease control. Despite many social surveys being conducted, ADB (2004) points out considerable data gaps as well as the necessity to allocate responsibilities for generating such data to avoid duplication of functions.

In addition, a number of other organizations including research institutes, universities, NGOs, and individual researchers collect data and information in their areas of specialization as indicated in Table 13.1.

Existing Environmental Information

Collecting, compiling, and harmonizing information from different sources are often difficult tasks. Furthermore, collecting environmental data from secondary sources or descriptive data has proven to be a daunting task in Nepal. The past study on the State of the Environment Nepal and the present study are good examples and share the same experience. Except for data found in reports, reliable data are very difficult to obtain and many institutions lack the proper data handling capability. The problems include the fact that sources of environmental data and information are generally diverse and incoherent; the marked unwillingness on the part of most of the institutions and individuals to share data and information; and a lack of the data standardization and consistency that would make them usable under a common platform—often there are simply no data available.

Circulation of environmental information should be stimulated at the national level. Issues emanating from the present institutional context need to be addressed to improve the environmental data and information available in Nepal.

Integration and Analysis of Environmental Information

The information required for environmental assessment and monitoring covers a wide spectrum. There is an increasing need for better integration of environmental concerns into decisions that can affect the environment in major economic and human activities such as energy, industry, transport, agriculture, and tourism. Information on the natural resources base and environment is essential. Information on human activities impacting the environment, emission of pollutants, natural events, and human responses to environmental changes is equally important for assessing the ecosystem as a whole.

Careful integration of environmental data into social and economic dimensions is increasingly recognized as vital for scientific understanding and societal decision making (Maclaren et al. 1994). This has a number of implications for the collection, management, and use of information, including the necessity of synthesizing and presenting scientific and technical information in readable, usable form, and of displaying the links between environmental and socioeconomic issues. Such integration can be fostered by proper institutional mechanisms as well as by using modern analytical tools and decision-support systems, which will support better understanding of environmental trends and conditions and help develop and implement policies, plans, and actions. The following section describes the use of such modern scientific tools.

Geographic Information Systems (GIS)

Environmental problems have distinct spatial and temporal dimensions. From an operational standpoint, data must be referenced geographically. Decisions related to the environment, protection of biodiversity, environmental damage due to natural hazards, urban growth, and so on need information through space and time. Due to the very high variability in topography and ecological characteristics, Nepal poses challenges in compiling and analyzing such information.

Advanced information communication technology, GIS, and space technology represent a new generation of tools for scientific analysis. Myriads of these tools are converging and are now available to quantify, model, document, and disseminate information on key environmental and natural resources conditions and trends. The information thus generated is readily understood by policymakers and the public. GIS technology is

relevant due to its multidisciplinary nature that allows integrating divergent sources of data, spatial modeling, and visual presentation; using such tools calls for close collaboration among many sectors. Availability, accessibility, and affordability of geographically referenced information at multiple scales, and the capacity to use modern decision support system tools are crucial to investigating key environmental problems.

Importance of Spatial Information

Information portrayed in maps is an essential tool for assessing the state of the environment (UNEP and UNDP 1994). From a spatial context, the analysis of environmental conditions and trends can be presented by administrative boundary, environmental units such as watersheds, or eco-regions. As socioeconomic data are based on the administrative units, it is convenient to map environmental impacts due to human activities in these units. The ecological framework approach demands better understanding of natural processes, and a natural resource based approach using watersheds or eco-regions is suitable for environment assessment. Such analyses can be accomplished through the use of GIS (Bajracharya 2000).

Many spatial data are considered core environmental information such as topography, land use, ecology, drainage networks, geology, infrastructure, and so on. In Nepal, such information is reasonably well developed but needs regular updating. Figure 13.3 provides examples of these types of information layers prepared by ICIMOD's Mountain Environment and Natural Resources Information Systems (MENRIS) program using data from various government sources.

ICIMOD and CBS have also carried out extensive mapping of socioeconomic indicators and trends using census information, which included health and environment information; an example is shown in Figure 13.4.

Environmental GIS Applications

Through its MENRIS program, ICIMOD has adopted a strategic approach to promoting and using GIS for environmental and natural resources management for mountain areas among its member countries. Figure 13.5 shows typical examples of some of these environmental applications in Nepal; they demonstrate the potential for using GIS.

Remote Sensing

Remote sensing (RS) observations from satellites provide data on the earth in a spatial format. The last decade witnessed unprecedented growth and

Figure 13.3: Examples of Information Layers for Nepal prepared using data from Government Sources

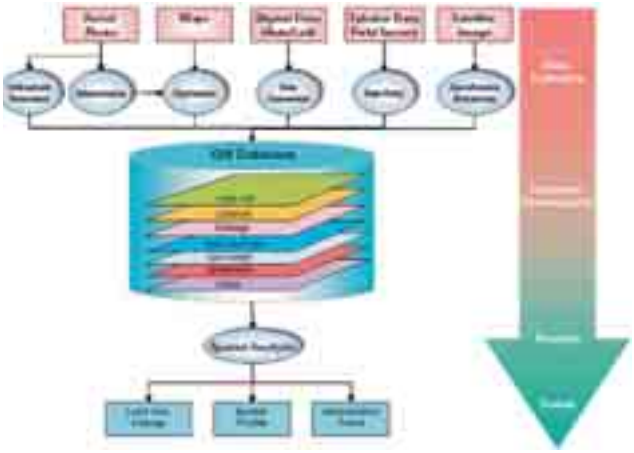
Source: Mountain GIS Portal (www.icimod-gis.net) MENRIS, ICIMOD.

Figure 13.4: Mapping of Socioeconomic Indicators Using Census Information – Sources of Drinking Water

Source: ICIMOD (2003)

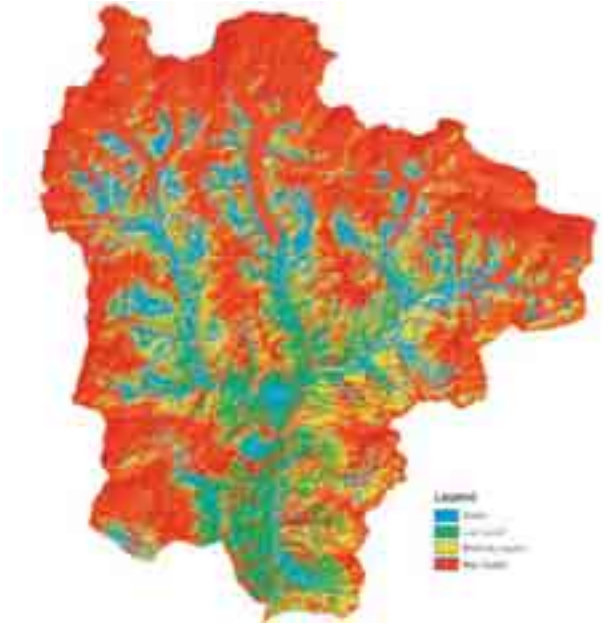
Figure 13.5: Examples of Environmental Applications of GIS

a) GIS in Urban Environmental Planning



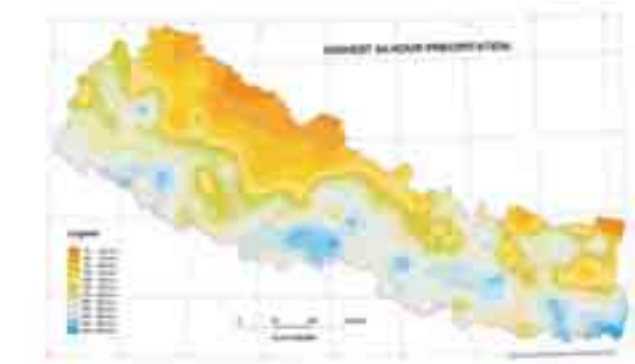
Source: Shrestha t al. (2003)

b) Hazard Map of Sagarmatha National Park
(Criteria based on lithology, slope, and land cover)



Source: MENRIS, ICIMOD.

c) Climatic Atlas Mapping



Source: MENRIS, ICIMOD.

development in earth observation techniques. The trend is continuing, and remote sensing techniques are proving to be more cost effective than ground-based ones. RS data have benefits from the synoptic view and large area coverage, which help in obtaining a "bird's eye-view" of the features. Remotely sensed data have a huge potential for providing time series data on environmental conditions of dynamically changing resource bases. The availability of RS data in a temporal domain (as short as 3–20 day intervals) provides a new dimension to spatial information processing and monitoring of earth features. Furthermore, in recent years high-resolution satellite data have provided a greater degree of spatial and temporal variations than ever before. Global positioning system (GPS) technology has revolutionized surveying and mapping. The increasing availability of public domain datasets from RS techniques, the declining trend in the cost of computer hardware, the exponential increases in computing power and the expansion of the Internet, and increased user-friendliness of software are other welcome developments. These developments create a suitable context for using remote sensing for environmental monitoring. The recent release (June 2005) of the GoogleEarth product (http://earth.google.com) has allowed ordinary Internet users to view interactively a 3-D globe based on satellite imagery.

In the present context, remotely sensed data provide a means to integrate the information required to assess and monitor ecosystem sustainability. Virtually all modern map products derive considerable information from remote sensing. Recent developments in space technology suggest that the future will bring a wide variety of products for environmental monitoring and assessment. The recent UNEP Atlas "One Planet Many People" used satellite imagery extensively to assess and monitor the earth's environment (UNEP 2005).

ICIMOD has been promoting the use of RS in the greater Himalayan region and applying RS techniques to various environmental problems; some typical examples drawn from Nepal are shown in Figures 13.6.

Environmental Decision Support Systems

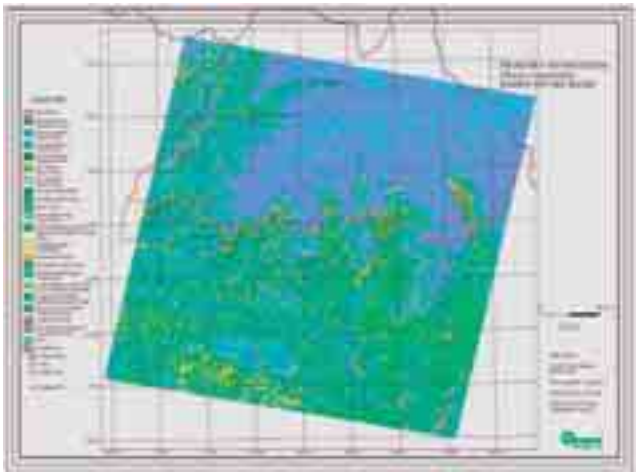
Environmental databases coupled with information systems and decision support systems are central to achieving a successful transition from the traditional (sectoral) environment and natural resources management to an integrated, holistic approach to development because of their integrative quality (linking biophysical and socioeconomic information)

Figure 13.6: Examples of Applications of Remote Sensing in Environmental Studies

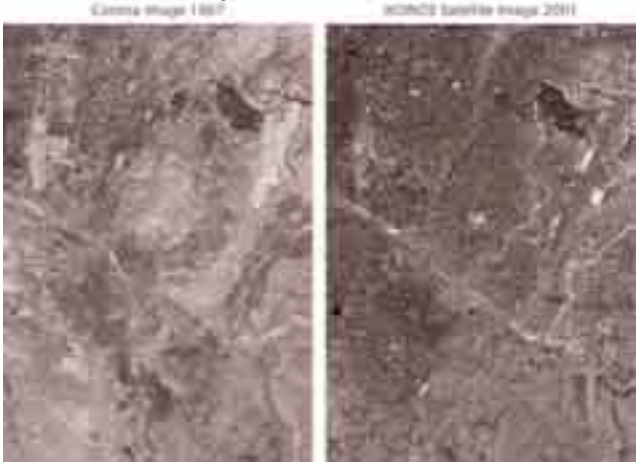
(Source: Mountain GIS Portal ICIMOD)

a) Mosaics of Natural View and Geocover of Nepal

b) Biodiversity Mapping Using Remote Sensing



c) Kathmandu Valley—Urban Growth (1967–2001)



and their location-based property (addressing relationships among places at local to national levels). Figure 13.7 illustrates the framework for environment and natural resources information and decision support systems adopted by the MENRIS program at ICIMOD for sustainable mountain development in the Hindu Kush-Himalayan region.

This framework is based on building the capacity of local and national partners, and creating an environmental information network. The framework provides a mechanism to assimilate both biophysical and socioeconomic information at multiple levels through an organized environmental and natural resources information network of local and national partner institutions. The framework defines the aggregation of geo-referenced environmental information with accepted international standards at local and national levels to give rise to integrated environmental databases. The databases serve as a foundation upon which analytical and decision making processes are based. The spatial modeling tools combined with thematic expert knowledge on priority environmental issues will help to analyze and model key components of the mountain environment such as biodiversity, climate change, snow and glaciers, land use and land cover, and infrastructure development. Ultimately, the framework is aimed at contributing to an increased knowledge base for environmental information and to decision-support systems.

The main functions of such an information and decision-support system are to facilitate access to environmental information and data sharing; promote the integration and harmonization of data through the use of GIS, the Internet, and related tools; and indicate alternative scenarios through scientific analysis of priority environmental issues.

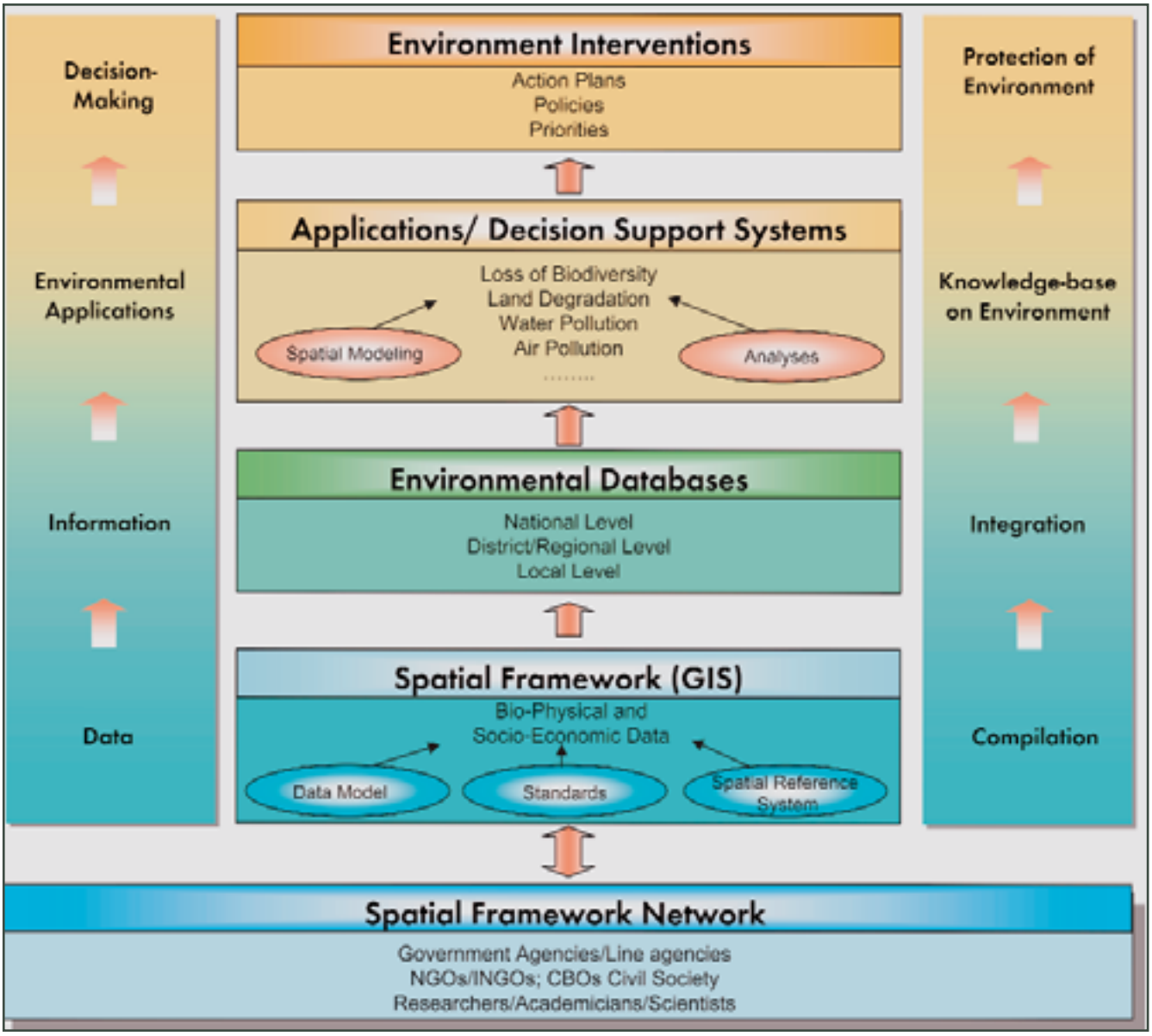
ICIMOD, together with partners, is currently developing a "Protected Areas Database Portal" of Nepal—a framework for sharing and exchanging information related to protected areas and biodiversity through the Internet with a dynamic mapping capability, and a database for a transboundary water quality monitoring network.

Conclusions: Challenges in Environmental Information

Developing countries like Nepal, where the environment is often treated as a lesser priority or even neglected, clearly face big challenges in tackling problems related to environmental information. Most often, analysts and policymakers lack the capacity to fully use environmental data and information to bear upon decision making. Some of the challenges and issues that Nepal faces in this regard are presented below:

(i) There is a general lack of awareness about what environmental information is available, and it is not easy to learn what work is being carried out at present or has been done in the past. There is neither a central record of

Figure 13.7: Framework for Environment and Natural Resources Information and Decision Support Systems



Source: ICIMOD/MENRIS Programme Brochure

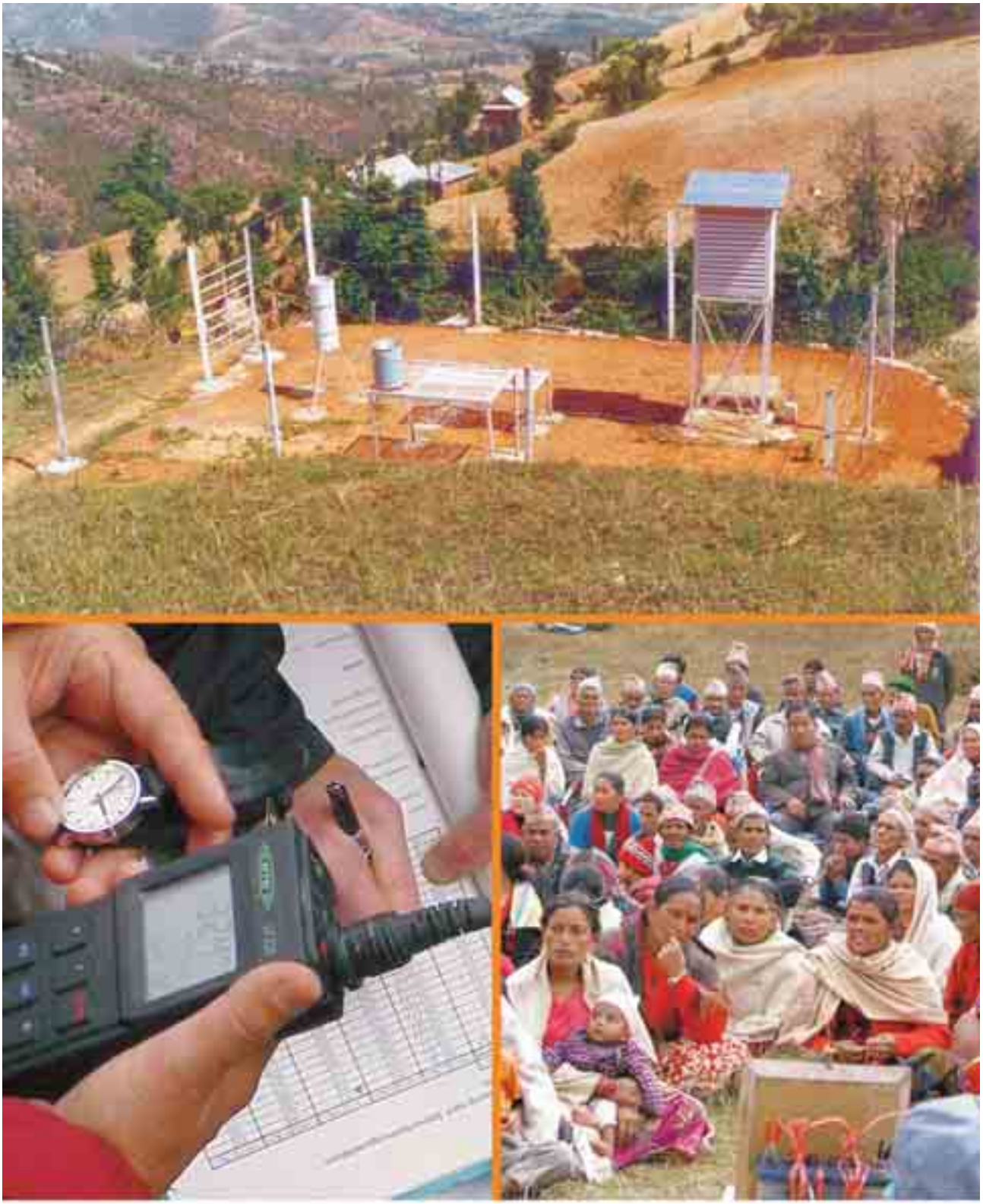
environmental information or meta-information, nor a comprehensive list of data sources, environmental publications, and reports. Often available information is communicated verbally, and little attention is paid to structuring the data in a computerized system. It is often easier for agencies to simply re-collect information.

(ii) There is no clear mandate or policy at the institutional level responsible for defining, maintaining, and updating environmental data and information. There is little or no interaction among institutions or projects, and their mandates, authorities, responsibilities, and functions often overlap.

(iii) The present level of information gathering on the environment is insufficient and important data gaps persist. There are gaps in terms of desired frequency and desired level of geographic disaggregation. Even where data are available, they remain sectoral in nature and most often incompatible across sectors, areas, and time.

(iv) Many organizations use different methods for acquiring, storing, processing, analyzing, and presenting environmental data and information. Harmonization of environmental data and information is difficult.

(v) Information networking between local and national levels remains weak, and coordination among the line agencies for effective data sharing is non-existent. The data sharing culture remains poorly developed.



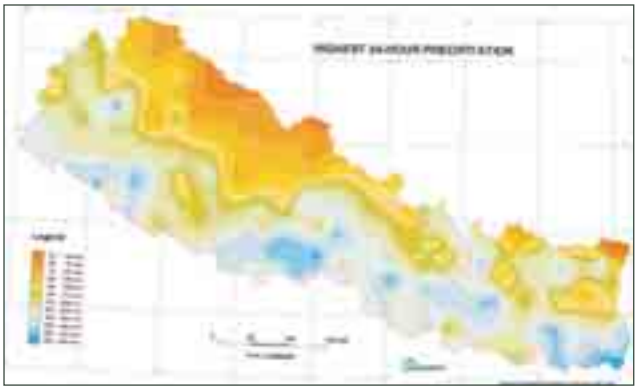
Gopal Nakarmi

Judith Dobmann

Zbigniew Mikolajuk

There are many sources of environmental information: clockwise from top-weather station; demographics; measuring water flow

(vi) Many environmental issues such as loss of biodiversity, glacier melting, soil erosion, air pollution, and flooding transcend national boundaries. It is also necessary to strengthen a sense of collective ownership and responsibility for the environmental challenges faced at the regional/global level. There is a need to pursue effective measures of regional cooperation and to establish a regional network for effective sharing and exchange of environmental information.



Unless there is a strong political will and good governance, these challenges are unlikely to be met. For this, policymakers, user communities, and data producers need to be more aware of the benefits. Tackling problems related to environmental data and information requires establishing an environment and natural resources information network to facilitate the exchange of information and strengthen appropriate policymaking capacities. A unified repository would collect all relevant databases with the participation of government, nongovernment and academic institutions, the private sector, and other stakeholders. Such a network, which would integrate data and information from decentralized providers and make them available to a multitude of users, is an important concept, and doubtless a useful one, but needs to be strictly managed to make it viable. There are several needs related to this.

(i) Initially, existing structures need to be assessed and the capacity of the different sectoral agencies reinforced to allow them to generate and analyze multisectoral environmental and natural resources data and information more easily.

(ii) Sectoral agencies need to be coordinated so that the data and information collected are systematic and conform to a consistent information structure that ensures quality and reliability.

(iii) Socioeconomic and other sectoral data and information can then be harvested to derive policy-relevant, aggregated indicators for major environmental issues at the local and national levels.

(iv) An integrated environmental decision-support system focusing on priority environmental issues can then be developed to bring together existing knowledge and help facilitate assessments, trends, and projections in the area of environmental protection.

(v) To maximize its usefulness, Nepal's central repository of information would then need to be networked and linked with different regional and international agencies and with other well-developed and managed information bases dealing with similar types of information.

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Chapter 14

Emerging Priorities

Introduction

This chapter brings together the issues and priorities raised in the previous chapters. Because of the environment's strong linkages with livelihood activities and people's wellbeing, in both rural and urban areas, it can no longer be viewed in isolation as say only overcoming air and water pollution, critical as these environmental problems may be. The challenge for the future is to move away from narrow sectoral thinking and action. While efforts to develop organizations with cross-cutting mandates have not been very successful, and sectoral organization will still be the preferred choice for development activities, the challenge for integration, coordination, synthesis, aggregation, and disaggregation into sectoral responsibilities based on a holistic vision and work plan must now be resolved by those responsible for preparing interactive, up-to-date, knowledge-based systems of information networks and systems. This chapter discusses these key areas of focus in Nepal's environmental management.

Promoting Integrated Ecosystem Management and Sustainable Livelihoods

Sustainable Use of Resource Endowments and Ecological Niches

Past approaches regarding the management of natural resources and the reduction of poverty in rural areas of Nepal must be re-examined and reviewed. The Poverty Reduction Strategy Programme has been given the highest priority in the current Tenth Plan, but the environment and natural resources have not. This is worrying since the livelihood of the majority of Nepalese depends on subsistence agriculture and natural resources. Mountain households are neither able to generate economic surplus from subsistence activities nor to find stable off-farm employment. Unless employment and income opportunities are developed locally, the traditional reliance on subsistence activities is unlikely to alleviate the chronic and growing poverty in the mountain areas. The sustainable way to promote new employment and income opportunities would be to use the resource endowments and comparative advantages of ecological niches in a sustainable manner. The challenge is to transform the prevailing subsistence-oriented agricultural mode of economic production into one complemented by commercial sources of income. This will entail providing equitable access to gainful and sustainable markets within the scope of resource endowment and the comparative advantages of ecological niches. It will also be necessary to give project implementers sufficient latitude to discover the best ways to tackle problems, and to remember that this type of approach is still very new; the lessons have yet to be learned.

Past experience has indicated that biodiversity in rural areas provides many valuable environmental goods and services that are fundamental for meeting the basic needs of the poorest of the poor (MOFSC 2002). Agricultural households have understood the need for integrated management of plants, soil, and water resources—yet protecting these continues to be dealt with separately by development organizations. The promotion of economically and environmentally sound energy practices, the conservation of energy resources, and the development of alternative energy systems are all critical to reducing the pressure on limited natural resources. Similarly, many green enterprises such as non-timber forest products (NTFPs), medicinal plants, ecotourism and other income generating activities are necessary but cannot continue with a degrading resource base. Understanding the valuable contribution that traditional knowledge can make to sustainable resources management, promoting its use, and recognizing it legally will require many innovations in institutional mechanisms. However, all of these changes are unlikely to occur if the local people who are the guardians of the local resources do not have a voice regarding the access to, control, and management of these resources. Seeking opportunities to support

sustainable livelihoods requires an approach that can integrate all the actors by providing each with sufficient latitude for collaborative management.

Participatory and Collaborative Approach

The joint consideration of the ecosystem and livelihood comes closest to this collaborative approach. Focusing on the integrated management of land, water, and living resources, it seeks to promote conservation and sustainable use in an equitable manner. It recognizes the wealth of biodiversity, not only on account of its variety, but also because of the dynamic processes that occur between living organisms and their environment. These processes provide many essential goods and services that are critical for supporting life. The ecosystem approach embraces cultural diversity as an integral part of the ecosystem, since cultural attitudes to the environment influence many of the other processes that actively affect the ecosystem. People cannot be seen as separate from their ecosystem, and rich and poor all have a role to play as they are all part of the same system. Ensuring continued access to essential environmental goods and services for the poor and ensuring their continued collaboration is basic to any system that seeks to improve their livelihood, since past experience has shown that the environment deteriorates when users do not own and control the resources (NPC 2003).

Nepal includes many different interacting ecosystems. Indigenous people evolved appropriate adaptations to seasonal change so that the resources in different ecosystems were harnessed through seasonal migration. In more recent times, with decreasing transhumance of the population, this process has almost ceased to exist and now each ecosystem is under continuous pressure year-round. Experience has shown that with better environmental management this need not be the case (NPC 2003). Nepal's forests, high mountain grasslands, wetlands, and Siwalik hills are all under different environmental pressures and the challenge is to come up with innovative approaches for their sustainable management. The Terai Arc Landscape project is an important initiative that needs to be closely studied for its "lessons learned", particularly for the Terai which is the rice bowl of Nepal (MOFSC 2002). The Siwaliks are also experiencing tremendous changes with very far reaching implications, as are the high mountain areas, though many of these changes are not well understood (NAP 2002).

In the past there was a tendency to categorize all ecosystems as either forest or agricultural. Many rural development programs did not adequately understand or recognize the critical role that environmental goods and services play in household livelihood strategies (MOFSC 2002). This needs to change, and some of it is changing already. But clearly in a mountainous country like Nepal, it is necessary to develop and promote an approach that integrates both the ecosystem and livelihood in a unified approach to the rural economy and the environment.

Harnessing Ecological, Economic, Cultural, and Institutional Opportunities

Integrating ecosystems and livelihood opens up the possibility of harnessing ecological, economic, cultural, and institutional opportunities. Ecological opportunities for successful conservation are provided by Nepal's extensive system of protected areas, which already houses 80 of Nepal's 118 ecosystems. These protected areas contain many rare and endangered species of flora and fauna. While they face a number of problems, they nevertheless represent an important opportunity for the conservation of Nepal's unique natural resource endowments, and can contribute to environmental sustainability in terms of soil and water conservation, carbon sequestration, and biodiversity conservation. Equally important to the protection of conservation areas is the protection of their contiguous border areas. Natural ecosystems are not bound by human demarcations, and protecting the endangered species within conservation areas requires protecting outlying areas that are part of the same ecosystem.

The availability of unique natural resources makes it possible to consider and promote economic opportunities such as ecotourism. Small countries like Costa Rica have made very effective use of their natural resources in furthering economic opportunities, and Nepal needs to learn from this type of experience. Nature-based sports and outdoor recreation, for example, have great potential. Some parts of the country have already developed this with considerable success and are continuing to do so (IUCN 1999 and WWF 2000), but new areas can also benefit from this type of activity, particularly in eastern Nepal where infrastructure has reached a good level of development. In addition, cultural opportunities do not conflict with ecological and economic ones. In many historic sites, the culture, the economy, and the environment have functioned quite synergistically in the past, and this could be an important component of ecotourism in the future.

High-value products such as NTFPs, medicinal and aromatic plants, orchids, pheasants, butterflies, and other green-area-intensive products can be promoted on fragile slopes where landholdings are small. Rural markets near growing urban areas have considerable potential for trading these, thus provid-

ing income and employment opportunities for the poorest of the poor in production and post-production activities. NTFPs and medicinal and aromatic plants can be important supplements to the limited opportunities offered by traditional agriculture. NTFPs are important in the medical and cosmetic industries. Dabur Nepal (Nepal's foremost pharmaceutical company) and a number of other firms are leading the efforts in this area (MOFSC 2000, 2002, 2003a). In many hill and mountain communities this is providing an exciting alternative to a non-sustainable livelihood based on growing cereals.

Conservation for supporting sustainable livelihoods is already being practiced (e.g., KMTNC 2002). Future activities might include bio-prospecting and carbon trading. Bio-prospecting is a growing activity involving the search for new genes or chemicals of commercial value. Carbon trading, although somewhat complicated, could have potential in the future. If promoted carefully there could be valuable benefits and an important opportunity for better integration of ecosystem conservation with livelihood development. The major lesson to be learned here is that the local communities can become guardians of their own natural resources when they are given the responsibility as well as the support to protect, rehabilitate, and benefit from those resources.

Water is a plentiful resource that remains relatively underdeveloped. Hydropower has enormous potential and if developed in conjunction with policies to plough back a part of the earnings into the area, it could also be a very important source of income for local livelihood development. The forests of Nepal have been very important in the economy and with proper management sustainable benefits can be reaped from developing this resource (MOFSC 2003a).

Institutional opportunities are now available because of recent legal changes such as the Local Self-Governance Act 1999. Improving ecosystem services so that the people depending on ecosystem resources can reap their full benefit is the only way to encourage ecosystem conservation and sustainable use. Without substantial improvements in these services, however, there is a great danger that the environmental degradation process could accelerate further. In the past, the main focus has been on the management of an existing stock of natural resources, particularly in forests. The challenge now is not only to define ecosystem services in a broader perspective but also to find ways to augment them. There is a need for better understanding of different ecosystems, updating the biodiversity database of Nepal, and integrating ecosystem management and livelihood strategies with regional development.

Decentralized and Transparent Decision Making

The stumbling blocks that remain are monopolies by the public sector, disabling laws, and extremely slow decision making by a centralized government. Different local and national opportunities with respect to resources have been neglected, and this is unlikely to improve without significant changes in the management and control of these resources. Regional development planning has also been neglected. Many of the regional disparities in livelihoods are linked with the poor commitment to regional development. The ecosystem and livelihood focus necessitates a stronger move towards concrete regional development planning and implementation in Nepal. The present conflict in Nepal underscores this even more strongly. Unless marginalized and vulnerable groups get better access to available resources and economic opportunities, they become easy recruits for starting conflicts.

Promoting Integrated Urban Environmental Management

Although Nepal is still one of the least urbanized countries in the world, the urban population is growing rapidly. The population growth rate of the formally designated municipal areas is now 14%, and census data show that the urban population growth rate has exceeded the national population growth rate for the past half century (CBS 2003). The urban areas of Nepal are among the fastest growing in all of South Asia. Urban settlements[1] are expanding rapidly and new towns are emerging, particularly along the highways. Two basic factors contribute to this phenomenon: increasing rural-urban migration and high national population growth. Escalation of the armed conflict that began in 1996 has exacerbated this migration as increasing numbers of people flee the countryside to take refuge in urban areas.

The rapid increase of the urban population is, however, not matched by similar increases in providing and managing urban infrastructure and services such as roads, water, sanitation, and waste management. More often than not the expansion of settlements and the establishment of industries and facilities has been spontaneous, ad hoc, unplanned,

[1] The definition of urban settlement used in this discussion does not necessarily coincide with the administrative boundaries of municipalities, as it includes semi-urban and quasi-urban areas. Any settlement that shows a basic urban character can be defined as an urban settlement. Small towns including emerging towns that are not yet formally defined as municipalities are also in fact urban settlements, whereas significant parts of several formally defined municipalities may not have an urban character.

and haphazard. Population pressures are stretching limited infrastructure and services beyond their capacity. Visible signs include sprawling urban settlements, congestion, poor or nonexistent sanitary facilities, unmanaged dumping of solid and hazardous waste, and degraded and polluted urban air and water. The most serious adverse effects attributed to the deteriorated urban environment are related to health. Unplanned and haphazard urbanization also encroaches on open spaces, agricultural and marginal lands, and heritage sites. The emergence of urban slums and urban poverty in Nepal's cities is a relatively new phenomenon and still minor when compared with the problem faced by major cities in South Asia.

The Guided Land Development and Land Pooling Acts are two government initiatives to plan and guide urbanization in some municipalities. These are aimed at facilitating the adjustment of land plots so that space is provided for urban infrastructure—roads, water supply, drainage, electricity, and telephone. Provision for urban infrastructure in Nepal has been largely driven by central sectoral institutions such as the Nepal Water Supply Cooperation, the Department of Roads, the Solid Waste Management and Resource Mobilization Center, the Nepal Telecommunications Corporation, and the Nepal Electricity Authority. Recently, after the enactment of the Local Self-Governance Act 1999, municipalities are being increasingly empowered to manage their urban areas. However, in spite of good intentions, the municipalities generally lack the capacity and resources to do so. The Town Development Fund was established in 1997 to provide financial resources, loans, and technical assistance to local bodies to help them implement town infrastructure projects. However, the lack of coordination and mutual support among the institutions remain the main stumbling block in the planning, construction, and maintenance of urban infrastructure and facilities. Institutional confusion regarding the assignment of responsibility, authority, and handling of resources remains contentious.

The Kathmandu Urban Development Project that began in 1993 was the first Asian Development Bank (ADB)–financed urban sector project in Nepal. An operations evaluation mission evaluated it in 2003 (ADB 2003) and reached several conclusions:

(i) The project was adequately designed from a technical perspective, but public participation was not sufficient to ensure sustainability.
(ii) The land pooling scheme devised in the project has become a model for other land pooling schemes. An integrated environmental management system that could comprise water supply, groundwater recharge, rainwater harvesting, wastewater recycling, and wastewater treatment could also be implemented.
(iii) Population in the project area exceeded the projection, resulting in overuse of infrastructure or its inadequacy. Infrastructure was poorly maintained. Maintenance requires adequate financing (one source of which could be property tax) and institutional capacity (training and capacity building of staff, and so on).
(iv) Community networking and training should continue beyond initial project implementation. Nongovernment organizations (NGOs) can play a crucial role in building awareness of proper operation and maintenance.

Since completing the Kathmandu Urban Development Project, the ADB has financed several other projects related to the urban sector. These include the Melamchi Water Supply Project ($120 million), Small Towns Water Supply and Sanitation Sector ($35 million), Kathmandu Valley Water Services Sector Development Program ($10 million), and Urban and Environment Improvement ($30 million). Other donors have also provided support for urban infrastructure and services. For example, German Technical Cooperation (GTZ) supported solid waste management in Kathmandu, and urban development through local efforts in several municipalities; United Nations Development Programme (UNDP) and the World Bank supported the Metropolitan Environment Improvement Programme; Danish International Development Agency (DANIDA) supported the Environment Sector Programme Support; and the European Union supported the Kathmandu Valley Mapping Programme.

Important lessons regarding urban environmental management in Nepal can be derived both from donor-supported programs and from the small-scale environmental activities of NGOs. These two sectors have been involved in converting waste into resources (through composting, making briquettes from waste, paper recycling, management of solid wastes by communities, and others), in promoting alternative approaches to waste/sewage treatment, and in addressing the needs of the urban poor (including slums and squatters' quarters). Integrated environmental planning and management can also benefit from the process of integrated action planning[2] tried in some municipalities.

[2] Integrated action planning is based on people's participation. Ward level community meetings are the cornerstone of this approach. Other features are mobilisation and participation of the community in the identification, prioritisation, and programing of municipal development activities and making the planning process more people oriented.

Urban development and management in Nepal lack both an integrated, holistic approach and a long-term vision. Although master plans have been prepared for some municipalities, implementation of these has been weak and generally unsatisfactory. Most past efforts have been sectoral and uncoordinated rather than integrated. A truly integrated and holistic approach should therefore be promoted for urban environmental planning and management to make urban areas better places to live.

There are obvious linkages and complementarities among the various urban infrastructures and services; if these were integrated and coordinated properly, the synergistic effects could be enormous. For example, solid waste management is linked with air pollution and the functioning of drainage. A truly integrated and holistic approach, however, should not be limited to integrating and coordinating infrastructure and services, but should include wider concepts of integration like the following:

(i) Planned land use with due consideration given to environmental attributes (urban ecology, environmental setting of urban surrounding areas, open spaces, religious and cultural heritage, conservation of water, agricultural lands, and other resources).
(ii) Introduction of waste reduction/reuse/recycling in keeping with environmentally-friendly practices.
(iii) Raising public awareness regarding the environment, health, and appropriate practices and behaviors.
(iv) Promoting participation and partnership among communities, civil society, NGOs, community-based organizations (CBOs), and the private sector in environmental planning and management.
(v) Addressing urban poverty and the needs of the urban poor.
(vi) Introducing a "polluter pays" principle that can generate revenue for urban environmental management.

It is necessary to strengthen the municipalities, local bodies, and competent authorities for integrated urban environmental management; and to develop appropriate tools, and human and financial resources. It may also be necessary to reinforce the legal framework for promoting land-use planning, participation by stakeholders, and ensuring coordination and cooperation.

Such integrated urban environmental planning and management can build upon the experiences gained in the country and outside. The experience acquired from the ADB-funded Urban and Environment Improvement, and Small Towns Water Supply and Sanitation Sector projects, both of which invest in urban areas outside Kathmandu, can be useful (ADB 2002, ADB 2000). Initially the best of these ideas on integration can be piloted in small and emerging towns where the problems are still not very complicated. The integrated approach could then be promoted in bigger cities like Kathmandu where greater and more concerted efforts are necessary. For example, satellite settlements may be planned, developed, and managed at several locations in Kathmandu Valley taking into consideration all of their environmental attributes and implementing the wider concepts of the integrated approach. These settlements could then be linked to the main city through radial roads from the current ring road—the radial roads can also link to the outer ring road whose development is being supported by the Government of the People's Republic of China.

A related program may be designed to reforest the hills around Kathmandu Valley; this would have a number of environmental benefits, including groundwater recharge and ecotourism promotion. Possible areas of synergy include the ADB-funded Melamchi Water Supply Project and the Kathmandu Valley Water Services Sector Development Program, which aim to improve water supply and sanitation situation; these could be coordinated with upcoming projects in solid waste management supported by Japan International Cooperation Agency (JICA).

Institutional Strengthening and Capacity Building

About half of the prevailing key environmental laws now in force in Nepal (Appendix 14.1) date from after 1992 when the Ministry of Population and Environment (MOPE, since 2005 absorbed into the newly-formed Ministry of Environment, Science and Technology [MOEST]) was first established. Widespread public concern over pollution led to legislation to curb emission of effluents and airborne pollutants; while concern over the depletion of natural resources led to legislation for the preservation of conservation areas such as national parks and wildlife areas with special biodiversity value. While the laws exist in principle, institutional weaknesses continue to prevent their effective monitoring and implementation.

Institutions at all levels are weak, including the National Planning Commission (NPC), line ministries, local governments, and village committees. The requisite technical skills are commonly lacking and poor morale is a systemic

issue. These deficiencies stem from the general weakness of the public administration system itself—over-staffing, low salaries, political interference in appointments and transfers, inadequate performance recognition, and others are systemic. These in turn affect resource management. The capacity to monitor the implementation of laws and public expenditure is weak at all levels. Inadequate supervision, poor financial management, dilatory government procedures, and lack of coordination among government entities all lead to poor performance generally and to a serious neglect of environmental issues in particular.

Nepal needs to build up its capacity for national and regional development so that it can participate effectively in the global economy. There is a need to strengthen the public and private sectors, institutions, systems, processes, procedures, and practices that support development efforts. Improved capacity is needed to entrench and sustain good governance, design and manage effective policies and programs, manage the environment, address poverty, and apply science and technology to development problems. Capacity is also needed to accelerate regional development and for Nepal to participate with other regions as an effective partner in the global economy.

Policy Reforms

Nepal began its work in environmental protection and conservation of natural resources in the 1970s. However, the policies, strategies, plans, and programs of the ensuing 30 years have not been overwhelmingly effective. The policies themselves were unable to address cross-cutting issues; continuous interference by political parties, the inability of national level advisory bodies to function properly, and the inability of policy-level institutions to implement policy due to lack of fundamental resources all contributed to this failure. Key national agencies like the NPC and sectoral ministries have not been proactive in implementing approved policies and programs, and the Government has failed to attract the participation of the private sector.

These shortcomings in policy planning and implementation should be addressed quickly by (i) reviewing all existing policies on the environment and updating them as needed to make them relevant to present needs, (ii) revisiting monitoring and implementation mechanisms, (iii) attracting the broader participation of private sector institutions, NGOs, local bodies, and community-based organizations (CBOs) in the process, and (iv) coordinating national environmental policies with donors' policies where possible.

Institutional Strengthening

Strengthening environmental institutions involves overcoming existing endemic weaknesses and revitalizing institutions. In this regard a Technical Assistance (TA No. 2847-NEP) on Institutional Strengthening of Ministry of Population and Environment was provided by ADB. One of the recommendations from this Technical Assistance was implemented as the Integrated Environment Management Program and funded by DANIDA. In spite of this, various other aspects still need to be encouraged.

Major stakeholder institutions in the environment sector include public sector bodies, corporate bodies, and others operating outside of the public sector (see Appendix 14.2). The unsatisfactory performance of these institutions is due largely to their lack of capacity. These institutions are weak and their organizational structures often do not fully correspond to their mandates. Advisory bodies often do not perform professionally, and policymaking and corporate bodies are often not held accountable. These institutions also suffer from a lack of skilled professionals, lack of funds, shortage of technical and logistic facilities, weak interagency coordination, and conflicting and overlapping mandates. At the same time, the Government has failed to empower municipalities and to creatively engage private-sector organizations such as national and international NGOs, local bodies, and community-based organizations in meaningful dialogue.

MOEST is already overburdened by its role of formulating and implementing policies, plans, and programs. It might be possible to alleviate some of this burden and to streamline the environmental monitoring process by empowering and strengthening local bodies and institutions to take over some of the routine monitoring tasks. MOEST would remain the main coordinator of these efforts without having to directly implement them, and could encourage a growing pool of environmental experts to supervise implementation of measures to mitigate environmental impacts. As the expertise of this group grows, they will increasingly be able to give field-level feedback to MOEST and to advise it on environmental policy. Similarly, district development committees (DDCs) and village development committees (VDCs) can be empowered to act more autonomously within the framework of local self-governance and can be given the tasks both of bringing environmental and natural resource management concerns to the attention of MOEST and of carrying out some local environmental monitoring. Involving the VDCs would go a long way to ensuring that information acquired through broader public consultation was brought to the attention of policymaking bodies.

To overcome the constraints imposed by conflicting mandates, it might be necessary to review critically the existing legislative measures, devise their enforcement modalities, and consolidate all legal provisions under a single comprehensive umbrella legislation. Such integration might facilitate governance and harmonize the regulation of all environmental actions taken nationwide. Another possibility would be to consider the establishment of a National Pollution Control Board/Authority (to be at least partially managed by the private sector) whose chief responsibility would be to oversee pollution issues and enforce compliance with environmental standards. Similarly, with growing awareness on the part of the public it may now be timely to consider creation of an independent Environmental Rights Commission to protect the environmental rights of citizens.

Technical training is needed at all levels, and MOEST and other agencies involved in environmental monitoring need more and better skilled professionals to carry out their mandates. These need to have career development opportunities and to be encouraged and rewarded. They also need to be supplied with appropriate tools and equipment so that they can carry out their assigned tasks. Research and laboratory equipment are in short supply all around, and this situation needs to be addressed.

Improvements to the Legislative System

A large number of environmental acts and regulations have been promulgated in Nepal (see Chapter 9) to facilitate the implementation of environmental plans and programs, but these have had only limited success. This legislation now needs to be updated and amended to make it responsive to the present-day requirements of complex environmental concerns. In addition, new regulations are needed to help Nepal take full advantage of World Trade Organization (WTO) membership.

Trade and Environment

Nepal recently became the 147th member of the WTO. The main aim of membership is to improve Nepal's economy by opening up trade with the world. Before being able to reap the full benefits that WTO membership implies, policymakers and businessmen need to be aware of how to make the most of these opportunities and how not to be overcome by open trading. One of the commitments made by Nepal was to amend the Environment Protection Act 1996 to compliment requirements of WTO agreements related to trade and environment; this is discussed below. Nepal also needs to develop additional environmental standards for protecting human and plant life, and to consider issues like trade related intellectual property rights (TRIPS), which have threatened the rights of developing countries' farmers rendering them more vulnerable and marginalized. Another thorny and delicate issue under the WTO is that of agricultural subsidies, which many poor WTO members believe harm their exports. Building the capacity of environmental cells in the Federation of Nepalese Chambers of Commerce and Industries and other major associations of commerce and industry will be required. Industries should be motivated to adopt and comply with International Standards Organization (ISO) standards and ecolabeling of industrial products.

Enforcement of Environmental Laws

The environmental laws and regulations that do exist are only weakly enforced. Nepal's poor performance in the environmental sector has, in large part, been the failure to fully empower regulatory bodies to enforce regulations, monitor compliance, and impose penalties. The environmental commitment of institutions nominally responsible for enforcement, such as NPC and MOEST, is weak and enforcement is piecemeal; there is a lack of coordination among the different agencies.

A strong institutional base is needed to monitor and strengthen the legal instruments applied to environmental conservation. In many cases law enforcement is thwarted due to poor institutional infrastructure, the lack of institutional decentralization, or the constant shifting of responsibilities from one institution to another. A strong, transparent, and effective monitoring system is needed to support proper enforcement of laws and regulations. For example, to comply with international treaties, a list of rare and endangered species has been prepared. The difficulty, however, is that there is no scientific monitoring to ascertain whether these species are actually still endangered or rare. Surveillance of legal instruments both internationally and nationally is lacking. Creating a repository of all the relevant environmental information in the country and making it accessible to all stakeholders through electronic means would help to make the system more transparent and easier to enforce. The section below on an "Environmental and Natural Resources Information Network" begins to address this issue.

Strengthening the EIA/SEA Framework

Under the provisions of the Environment Protection Act and Environment Protection Regulations, the technical, industrial, and socioeconomic impacts of development projects on the environment and the

population must be assessed. MOEST must approve the requisite environmental impact assessment (EIA) reports before any project is started. Projects without significant environmental impacts only need an initial environmental examination (IEE) to be conducted by relevant agencies. The NPC has adopted and applied the concept of strategic environmental assessment (SEA) for project development policies and programs included in the Tenth Five-Year Plan (2002–2007). While the EIA assesses environmental impacts of development projects at the project level, the SEA assesses impacts at the planning, policy, and programming stages and can be used in evaluating strategic proposals for appropriate decision making.

EIA and SEA capacity issues are acute. The EIA is still largely considered to be an "add-on" project burden, and EIA reports are commonly based on inadequate data. Although the then MOPE (now MOEST) has already approved 25 EIA reports from different projects, it has not been able to monitor the proposed mitigation of identified impacts, and there is no indication that its successor MOEST will do any better. Recent experience based on a cross-section of development projects shows that the EIA process is usually enforced only as part of the initial approval process. The problems come later at the implementation stage. Some common constraints faced during implementation of EIA measures are summarized in Appendix 14.3.

Capacity development in augmenting, mobilizing, and enhancing Nepal's EIA and SEA capability must be strengthened. The knowledge, tools, and skills necessary to operate an EIA or SEA system to an acceptable level of performance must be developed. The scope of capacity development can range from establishing preconditions for EIA or SEA development to benchmarking good practices. Supporting measures include research, policy analysis, institutional design, information exchange, training and skills transfer, building networks, professional development, and guidance on implementing good practices. Appendix 14.4 presents some operational problems identified in the implementation of the EIA process, together with recommended solutions.

Environmental and Natural Resources Information Network

Informed decision-making must be based on accurate data and information. The synthesis and analysis of basic environmental data yields the information that is the precondition for developing a policy framework, policy design, and the plans and programs for environmental and natural resource management. As the population at large becomes sensitized to environmental issues, there is a growing interest in analytical data on the environment. The demand for environmental information is escalating and governments and other stakeholders in civil society have been the driving forces both on the supply and the demand sides. Good, reliable data on Nepal is clearly recognized by all stakeholders as a fundamental tool for development.

Although over the years considerable environmental data and information have been compiled by various institutions, aid projects, and individual researchers, this information has been difficult to access. Data appear in isolated reports, and are often dispersed, heterogeneous, and inaccessible; more often than not, they are insufficiently relevant in terms of continuity and reliability. Without an appropriate framework and mechanisms for data sharing, time and resources are wasted in the duplication of efforts. Public and private environmental institutions and bodies in Nepal have accumulated environmental data and information on natural resources and environmental conditions. These databases lack a centralized data pool and unified standards. At the national level there is no national information database integrating all the data, nor are there any data linkages that would allow the sharing of the existing information.

An environment and natural resources information network must be established to facilitate the exchange of information, strengthen appropriate policymaking capacities, and be a real tool in the attempt to tackle environmental problems. A unified repository would collect all established databases of major environmental concerns with the participation of government, nongovernment, and academic institutions; the private sector, and other stakeholders. Such a network, which would integrate data and information from decentralized providers and make them available to a multitude of users, is an interesting concept, and doubtless a useful one, but one that needs to be strictly managed to make it viable. Some potential management issues are described below:

(i) Initially, the existing structures need to be assessed and the capacity of the different agencies reinforced to allow them to more easily generate and handle multisectoral environmental and natural resources data and information.

(ii) Sectoral agencies need to be coordinated so that the data and information collected are systematic and conform to a consistent information structure that ensures quality and reliability.

(iii) Socioeconomic and other sectoral data and information can then be harvested to derive policy-relevant aggregated indicators for major environmental issues at the local and national levels.

(iv) An integrated environmental decision-support system focused on priority environmental issues can then be developed to bring together existing knowledge and help to facilitate assessments, trends, and projections in the area of environmental protection.

(v) To maximize its usefulness, Nepal's central repository of information would then need to be networked and linked with different regional and international agencies and with other well-developed and managed databases dealing with similar types of information.

Many issues—in particular, environmental issues such as loss of biodiversity, glacier melting, soil erosion, air pollution, and flooding—transcend national boundaries. Actions to combat these in one country often have profound regional or global ramifications. This is especially true regarding the environmental degradation and depletion of natural resources that have intensified in the recent past. In deciding on specific actions at the national level, it is necessary also to carefully assess regional implications to avoid harming other countries. It is also necessary to strengthen a sense of collective ownership and responsibility for the environmental challenges faced in the Himalayan region. There is an urgent need to pursue effective measures of regional cooperation to establish a regional network for effective sharing and exchange of information for sustainable decision-making on key transboundary environmental problems.

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Appendix 14.1: List of Key Environmental Laws and Related Legislation in Nepal

For completeness, this list includes some Acts that have been superseded by later Acts and are no longer in force. Only some amendments have been listed.

Ancient Monument Protection Act, 1956
Private Forests Nationalisation Act, 1957
Forest Protection Act, 1956
Civil Aviation Act, 1958
Aquatic Animals Protection Act, 1961
Forestry Act, 1963
Forest Protection (Special Arrangements) Act, 1967
Plant Protection Act, 1972
National Parks and Wildlife Conservation Act, 1973 (amended 1974, 1982, 1989, 1993) and Regulations, 1974
Public Roads Act, 1974
Tourism Act, 1978
King Mahendra Trust for Nature Conservation Act, 1982
Decentralisation Act, 1982
Mines and Minerals Act, 1985, and Regulations, 1999
Soil and Watershed Conservation Act, 1982, and Regulations, 1985
Nepal Petroleum Act, 1983
Solid Waste Management and Resource Mobilization Act, 1987
Pashupati Area Development Trust Act, 1987
Seeds Act, 1988, and Regulations, 1997
Kathmandu Valley Development Authority Act, 1988 (not enforced)
The Constitution of the Kingdom of Nepal, 1990
Pesticides Act, 1991
Industrial Enterprises Act, 1992
Social Welfare Act, 1992
Labour Act, 1992
Water Resources Act, 1992, and Regulations, 1993
Vehicle and Transport Management Act, 1992, and Regulations, 1997
Electricity Act, 1992,and Regulations, 1994
Forest Act, 1993 (amended 1999), and Regulations, 1995 (amended 2001)
Environmental Impact Assessment Guidelines, 1993
Environmental Impact Assessment Guidelines for the Forestry Sector, 1995
Nepal Civil Aviation Authority Act, 1996
Buffer Zone Management Regulations, 1996, and Guidelines, 1999
Nepal Tourism Board Act, 1996
Environment Protection Act, 1996, and Regulations, 1997 (amended 1999)
Town Development Fund Act, 1997
Drinking Water Regulations, 1998
Local Self-Governance Act, 1999, and Regulations, 2000

Appendix 14.2: Some Common Constraints Faced by Nepal in Implementation of Environmental Impact Assessment: Operational Problems and their Solutions

Based on the experiences of MOEST and other environmental agencies under the Government of Nepal, the following constraints and operational problems in execution of EIA related management plans have been identified in the country. Some recommendation solutions for resolving the operational problems have been provided here under.

Constraints faced

(i) There is a need for amendments of the provisions and clauses of the Environment Protection Act (EPA) and Environment Protection Regulations (EPR) themselves, to make them clearer and easier to follow
(ii) There are procedural delays within MOEST (formerly MOPE) whose accountability has never been questioned,
(iii) Due to lack of competent staff, MOPE failed to carry out the needed interventions in the EIA process, The newly formed MOEST will have to be more proactive in this regard.
(iv) There are technical difficulties in organizing public hearings at sites that delays the approval process,
(v) No concern has been demonstrated by apex agencies like NPC and NEPC about the ongoing unsatisfactory status of implementation of the EIA process,
(vi) Many sectoral agencies are carrying out the EIA process as a formality and due to the inability in the past of MOPE to administer and monitor the mitigation measures, the agencies concerned escaped punishment. MOEST will have to be more attentive in tackling these issues.
(vii) There are grievances from proponents and developers that the overall time required for following the process and preparation of EIA reports and their approval is too long.
(viii) In many cases, mitigation measures identified in the EIA reports are not undertaken, and the experience of one completed project is not taken into consideration while preparing and approving EIA reports for other projects.

Operational problems and their solutions

Problems

(i) There are inconsistencies and complexities in Schedules, which include list of projects requiring initial environment examinations (IEE) or EIA, format for terms of reference, and IEE and EIA reports. Some of the proposals requiring IEE or EIA are unclear and misleading.
(ii) The environmental law is silent about the time limit for the implementation of an EIA report. For example, the proponent may prepare an EIA report and then process it for implementation after a significant time lapse. In such cases, baseline conditions may change and many of the impacts and corresponding mitigation measures will also have to be altered.
(iii) The format and content of the Scoping Document has not been issued, which has reduced report quality. In recent years, copying of (EIA) reports and their duplication has been a major problem.
(iv) The reviewing agencies are unclear about the aspects to be reviewed in the Scoping Document and final EIA report due to lack of review guidelines and criteria. In most cases, consultants and practitioners are reluctant to review and redo the reports to improve their quality.
(v) In linear projects, a number of village development committees (VDCs) or municipalities may be affected. The law is unclear about the number of public hearings to be carried out at the project site, and number of recommendation letters of VDCs or municipalities to be submitted to the approving agency.
(vi) Most EIA reports have not shown linkages between the baseline conditions, environmental impacts, mitigation measures, and monitoring requirements.

(vii) The EIA report approving agency MOEST, has not been adequately effective in issuing directives on technical matters due to lack of competent and knowledgeable staff in the respective fields.
(viii) Environmental auditing by MOEST is usually meant to be undertaken two years after the commencement of the services of the projects, but the requirement is vague and provides opportunities to MOEST to delay environmental monitoring of the projects.
(ix) In many cases implementation of the environmental management plan approved in the EIA report is deferred. In some cases, EIA has been carried out after completing the detailed design of a project just to comply with the legal provisions.

Solutions

(i) Amendment of the Environment Protection Regulations, particularly its Schedules
(ii) Development of procedures for review of EIA reports, monitoring, and environmental auditing; establishing procedures for review of EIA reports by independent experts could be useful
(iii) Organize exposure/orientation programs on EIA procedures for senior decision makers
(iv) Launch special training courses for EIA practitioners and reviewers and officials involved in the process
(v) Make provisions for remunerating reviewers of EIA reports, independent monitors, and auditors of implementation of mitigation measures
(vi) MOEST should be supported in terms of funds and facilities to conduct monitoring of mitigation programs and conduct environmental auditing of completed projects
(vii) Provide logistics, vehicles, and other facilities to encourage site-visits before EIA report approval, conduct surveillance monitoring, and so on

Annex: Millennium Development Goals and the Environment in Nepal

Background

The Government of Nepal endorsed the United Nations Millennium Development Goals (MDGs) in September 2000 together with 188 other nations. However, the "MDG Progress Report 2002" points out that only two targets—improving safe drinking water and reducing child mortality—are likely to be met by the 2015 deadline.

This weak performance, not only of Nepal but also of many other developing countries, led to the introduction of an MDG needs assessment in the individual countries. The Needs Assessment looks at the time-bound targets, determines their implications for resources, examines linkages with ongoing development plans, for example in Nepal the Tenth Plan and the Poverty Reduction Strategy Plan. This exercise has been carried out in a number of countries already, and a methodology has been developed that has permitted a more realistic identification of the interventions and investments required to achieve the goals.

Environment and the MDGs

Millennium Development Goal 7

Millennium Development Goal 7 is to ensure environmental sustainability. According to Task Force 6 on Environmental Sustainability, this means the ability of communities of plants, animals, microorganisms, and their nonliving surroundings to sustain themselves and people far into the future. It includes providing critical ecosystem goods and services to people and other species.

There are three targets under Goal 7: Targets 9, 10 and 11.

Target 9: Integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental resources.

The indicators for monitoring progress are:

(i) proportion of land area covered by forest,
(ii) ratio of area protected to maintain biological diversity to surface area,
(iii) energy use (kilogram oil equivalent) per $1 GDP in purchasing power parity dollars,
(iv) carbon dioxide emission per capita and consumption of ozone depleting CFCs in tons, and
(v) proportion of population using solid fuels.

Target 10: Halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation.

The indicators for monitoring progress are:

(i) proportion of population with sustainable access to an improved water source, urban and rural, and
(ii) proportion of population with access to improved sanitation, urban and rural.

Target 11: Achieve a significant improvement in the lives of slum dwellers by 2020.

The indicator for monitoring progress is:

(i) proportion of households with access to secure tenure.

Other Millennium Development Goals

In addition to the targets directly related to environmental sustainability, there are a number of targets under each of the other goals that have direct or indirect environmental implications.

Goal 1: Eradicate extreme poverty and hunger

Most of the poor live in environmentally fragile areas: erosion-prone hillsides, semiarid lands, and tropical forest. In most instances the poor lack control over and access to natural resources. Many environments are already highly degraded, making it difficult to meet increasing demands for fuelwood, food, fiber, fodder, and others. Any strategy to reduce poverty and hunger cannot overlook these environmental concerns. The environmental dimensions of the Poverty Reduction Strategy Plan in Nepal need to be reexamined.

Goal 2: Achieve universal primary education

This goal has no negative impact on the environment. Including environmental awareness in primary education could have strong benefits for the environment in the long run.

Goal 3: Promote gender equality and empower women

It is critical to make women knowledgeable about the environment and conservation of biodiversity. Limited availability of natural resources adversely impacts women's work. Birth rates tend to be higher, children less healthy, and population growth more rapid where environments are degraded, leading to further pressures on basic natural resources for livelihood.

Goal 4: Reduce child mortality

Awareness of environmental sanitation may be critical. Better kept environments lead to better conditions of natural resources like water.

Goal 5: Improve maternal health

Sanitation is critical. Improved biodiversity may enhance nutrition and local availability of natural remedies.

Goal 6: Combat HIV/AIDS, malaria, and other diseases

Underlying environmental conditions—particularly waterborne and other infectious diseases—affect health. Good watershed management and pollution control are important. The relationship between infectious disease and changing environmental conditions needs to be studied more carefully. Availability of medicinal herbs for treating local health problems requires conserving biodiversity.

Other Key Points

In addition, a number of other key points may be noted:

(i) Activities with short-term benefits could have negative long-term environmental impacts that are not easy to mitigate. These impacts could lead to other consequences in terms of time (future), space (downstream), and sector (industry's impact on water or land).

(ii) It can be very difficult to motivate people to make environmental investments, as effects may occur somewhere else and not be felt immediately. By their very nature as public goods, the use of ecological services cannot be restricted to some and excluded to others.

(iii) Environmental sustainability requires dealing with immediate problems as well as taking a long-term perspective.

(iv) Environmental problems have various spatial dimensions (upstream–downstream), which need to be understood and approached appropriately.

(v) There are many global aspects to environmental change that should be dealt with at the global level.

For all these reasons environment is truly a crosscutting theme and relevant actions cannot be limited to a few areas. Environmental issues must be consciously addressed at every level of decision making. Without environmental sustainability, MDGs—even if they are reached in the short run—may face problems in the long term. It is equally true that, without meeting the MDGs, environmental sustainability may not be feasible.

Environmental Mainstreaming in the MDGs for Nepal

Environmental diversity and fragility are two sides of the coin in Nepal. If diversity has endowed the country with an amazing variety of ecosystems and scenic environments, these are delicately balanced by strong linkages between the different components which are easily disrupted. Once disrupted, ecosystem degradation is swift and people have realized through bitter experience that livelihood disruptions can follow very quickly. While some disruptions are natural consequences of changing weather or natural cycles, human impacts are also becoming important. A rapidly growing population, increasing urbanization, transport links, industrial activities, and developmental activities are contributing to environmental damage. The Government is making efforts on several fronts to deal with these problems but, while some notable decisions and impacts are evident, the problems are serious and increasing.

Since the early 1980s, the Government of Nepal has made several efforts to integrate environmental concerns into national development plans and programs. The Environment Protection Council (EPC) was established in 1993 and the Ministry of Population and Environment (MOPE) in 1995 to further develop and implement environmental policies and programs. Since then, there has been some progress in developing legislation, introducing environmental impact assessments, promulgating the Nepal Environmental Policy and Action Plan, enacting the Environment Protection Act 1996 and the Environment Protection Regulations in 1997, and developing standards to minimize the adverse effects of development activities on environment and health.

In addition, the Government has made a commitment to pursue an integrated policy to achieve sustainable development objectives. To meet the goals of Agenda 21 and the MDGs, the Government of Nepal has established the National Commission for Sustainable Development under the chairmanship of the Prime Minister. New policies and strategies are emerging, such as the National Wetland Policy, Terai Arc Landscape Strategy, Code of Conduct for Biodiversity, and the Action Plan for Herbs.

Nepal is actively participating in the MDG program. The National Planning Commission (NPC) of HMG, with the support of United Nations Development Programme (UNDP), is monitoring the progress being made in implementing the MDGs.

Progress regarding the achievement of the MDGs is at best mixed. With increasing economic difficulties and the continuing conflict, there are serious doubts regarding the fulfilment of the MDGs. UNDP's *MDG Progress Report 2005* has assessed Nepal's progress towards the MDGs and indicated a generally weak but improving situation. The disruption in economic activities and service delivery because of the persisting conflict has made the scenario even grimmer, requiring a careful reassessment of the efforts to successfully implement the poverty reduction strategy plan and the Tenth Plan, and monitor the progress on the different MDGs. A special concern here is Goal 7, Ensure environmental sustainability. While the other MDGs directly relate to different sectors, some like poverty and environmental sustainability cut across them. Furthermore, environmental issues may often be in conflict with some of the proposed sectoral measures. UNDP has commenced an exercise to improve the monitoring of progress related to the MDGs. This is a critical exercise and, if integrated with the implementation of the Tenth Plan, could provide an excellent monitoring mechanism as well as a sounding board for appropriate policy responses. Better integration of environmental components in this continuing exercise is fundamental to ensuring environmental sustainability.

Although Goal 7 has been listed as ensuring environmental sustainability and some targets have been identified, this is clearly not enough for a number of reasons. First, there are environmental implications to other targets besides those indicated in Goal 7. For example, Indicator 25 deals with the proportion of land area covered by forest but, to meet Target 1, the share of forest area under community control may be important. The real challenge is to take each target and its indicators and to see if a realistic, measurable sub-indicator for ensuring environmental sustainability can be identified. This will assist in indicating the cost being imposed on the environment in fulfilling different MDGs. Goal 7 alone cannot ensure environmental sustainability if the environmental implications of the other MDGs are neither understood nor tracked over time. A systematic inter-sectoral review of all the different aspects will help to develop the environmental sub-indicators for each of the targets.

The MDGs should not be seen as separate from the country's regular development plans. At present, the different line agencies that actually report on the progress of their sectoral activities do not appear to have internalized the MDGs.

Poor implementation of existing laws and regulations, virtually no monitoring of environmental problems and issues, lack of scientific data on some of the standards and site-specific parameters, and limited budgets for implementing environmental programs are continuing difficulties. Without addressing these issues, it is unlikely that environmental sustainability will improve.

Nepal's Progress Towards the MDGs: Status at a Glance

GOALS	WILL DEVELOPMENT GOAL BE REACHED				STATUS OF SUPPORTIVE ENVIRONMENT			
1 A. Extreme Poverty Halve the proportion of people living below the national poverty line by 2015	**Likely**	Potentially	Unlikely	Lack of data	Strong	**Fair**	Weak but Improving	Weak
1 B. Hunger Halve the proportion of people who suffer from hunger between 1990 and 2015	Likely	**Potentially**	Unlikely	Lack of data	Strong	**Fair**	Weak but improving	Weak
2. Universal Primary Education Ensure the by 2015 children everywhere, boys and girls alike, will be able to complete a full course of primary schooling	Likely	Potentially	**Unlikely**	Lack of data	**Strong**	Fair	Weak but improving	Weak
3. Gender and Equality Achieve equal access for boys and girls to primary and secondary education by 2005 and to all levels of education no later than 2015	Likely	**Potentially**	Unlikely	Lack of data	Strong	**Fair**	Weak but improving	Weak
4. Child Mortality Reduce under-five mortality by two-thirds by 2015	**Likely**	Potentially	Unlikely	Lack of data	**Strong**	Fair	Weak but improving	Weak
5. Maternal Health Reduce maternal mortality ratio by three-quarters by 2015	Likely	**Potentially**	Unlikely	Lack of data	Strong	Fair	**Weak but improving**	Weak
6 A. HIV/AIDS Halt and reverse the spread of HIV/AIDS by 2015	Likely	Potentially	**Unlikely**	Lack of data	Strong	Fair	**Weak but improving**	Weak
6 B. Malaria and Other Major Diseases Halt and reverse the incidence of malaria and other diseases by 2015	Likely	**Potentially**	Unlikely	Lack of data	Strong	Fair	**Weak but improving**	Weak
6 C. Tuberculosis Halt and reverse the incidence of tuberculosis by 2015	**Likely**	Potentially	Unlikely	Lack of data	Strong	**Fair**	Weak but improving	Weak
7 A. Environmental Sustainability Reverse loss of environmental resources	Likely	**Potentially**	Unlikely	Lack of data	Strong	**Fair**	Weak but improving	Weak
7 B. Access to Safe Drinking Water Halve the proportion of people without access to sale drinking water	**Likely**	Potentially	Unlikely	Lack of data	Strong	**Fair**	Weak but improving	Weak

Source: UNDP (2005)

MDG Needs Assessment Module for Nepal

According to the Nepal team (Zahir et al. 2004), the first purpose of the review was to unfold the workings of the templates so that the information fed into these templates and the results generated could be mapped in transparent ways. The second purpose was to make the templates Nepal specific.

The needs assessment for Nepal covered five sectors: (i) agriculture, irrigation, and food security; (ii) roads and other rural infrastructure; (iii) drinking water and sanitation; (iv) health; and (v) education. Environment and gender were to be treated as crosscutting themes.

The study team revised the templates on education, water and sanitation, hunger, and agriculture; it also developed a costing template for roads and rural infrastructure, although not included in the original MDGs, infrastructure is considered critical for Nepal to progress in all the MDGs. A module has also been developed for costing the health system.

The entire exercise has gone through many rounds of interaction, especially with the concerned line agencies. The main objective has been to make the exercise as realistic and consistent as possible with respect to the MDGs as well as with the country development goals and the plans and programs being implemented.

The main problem has been the extremely poor information base for many of the parameters used in the templates. The exercise has highlighted many critical data gaps that hamper such an exercise. It also emphasizes the need to substantially improve regular reporting across sectors to carefully monitor progress in meeting the MDGs. Cost information is a variable that has to be treated very carefully. For many of the interventions, cost figures were lacking and estimates from other areas had to be used. In other cases, "reasonable" estimates have been used. This underscores the need to review these templates regularly whenever new facts or conditions make this necessary.

Wherever environmental parameters are already being measured and reported, these are easy to incorporate in the cost calculations. However, at present, only a few environmental parameters, such as pesticide use or aspects of water pollution (based on measurement of waterborne diseases for some areas), may be directly integrated in the cost calculations. In all other cases, the costs have to be part of feasibility studies, training, and monitoring activities. There appears to be broad agreement among the different sectoral teams regarding this approach. The main findings of the study team are highlighted below.

Eradicating Extreme Poverty and Hunger

Goal 1: Eradicate extreme poverty and hunger

Target 1: Halve the proportion of people whose income is less than NRs 6,100 per capita per year at 2001 prices or NRs 16.71 per capita per day. The 2004 Nepal Living Standards Survey shows that only about 30% are below the poverty line, which is a significant improvement since 1995.

Target 2: Halve between 1990 and 2015 the proportion of people who suffer from hunger. This includes reducing the percentage of underweight children from 57% in 1990 to 28% in 2015.

Proposals to eradicate extreme poverty and hunger center around wider dissemination and adoption of agricultural technology, increased access to production inputs, commercialization and diversification within the sector, and market promotion and infrastructure development. At 2004 prices, the financial resources needed for 2005 were NRs 19,796 million, increasing to NRs 42,625 million in 2015. The total budget set aside for agriculture and irrigation was only NRs 6,026 million, which is 30% of the needed estimate for 2005.

Attaining Universal Primary Education

Goal 2: Achieve universal primary education

Target 3: Ensure that by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling.

The total cost of attaining the MDG on education for 2005–2015 amounts to NRs 334.5 billion at FY2005 prices. The average annual costs amount to NRs 30.4 billion at FY2005 prices, which is 20% higher than the Government primary education budget for FY2005.

Goal 4: Reduce child mortality

Reduce by two thirds between 1990 and 2015, the under-5 mortality rate and also immunize 1-year-olds against measles.

Nepal is on track to meet this goal, as in 1996 the under-5 mortality rate was 118 per 1,000, which decreased to 91 per 1,000 in 2000 and the target is to reduce this to less than 54 by 2015. Similarly, infant mortality stood at 78 per 1,000 in 1995, which is to be reduced to less than 25 by 2015. The cost per child was NRs 90 in 2005, increasing to NRs 327 in 2015.

Goal 5: Improve maternal health in Nepal

The target is to reduce by three fourths the maternal mortality ratio and expand deliveries attended by health care providers. Per capita cost is NRs 34 in 2005, increasing to NRs 86 by 2015.

Goal 6: Combat HIV/AIDS, malaria, and other diseases

Halting and reversing the incidence of HIV/AIDS, malaria, and other major diseases by 2015 to meet Goals 5 and 6 will require spending NRs 11,791 million in 2005 and NRs 24,192 million in 2015.

Water and Sanitation

Goal 7: Ensure environmental sustainability

Target 10: Halve by 2015 the proportion of people without sustainable access to safe drinking water and sanitation. The cost in 2005 was NRs 8,855 million, increasing to NRs 16,550 million in 2015. In FY2004, government expenditure in this sector was only NRs 2,025 million.

Rural Transport and Infrastructure

Although not a part of the MDGs, Nepal considers this area important for meeting MDGs. The target is to put in place rural infrastructure to ensure the necessary transport services and supply of energy resources to meet the MDGs.

Costs

The total cost to meet the needs for the years 2005–2015 amounts to NRs 1,130,439 million at FY2005 prices, or about $16,149 million.

The total financing gap varies based on the assumptions made and ranges from NRs 599 billion to NRs 538 billion. The latter scenario is based on the assumption of reduced security expenses.

The financing gap under the third scenario is 34% for hunger, 24% for education, 15% for health, 14% for drinking water and sanitation, and 13% for rural transport and electricity.

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The environment plays a crucial role in enabling and sustaining poverty reduction—and the effect is magnified within mountainous ecosystems such as those found in Nepal. Including environmental considerations in planning is a must, but to do this we need the relevant environmental data. In Nepal, environmental data and information can be difficult to find. Many data sets are unpublished—held in reports, ministry files, and others—much is inconsistent, and there are big gaps, especially in terms of time series and reliable, verified data.

The Environment Assessment of Nepal attempts to bring together a large part of what is available to provide an analysis of environmental status and trends in the country; the policy, legal and institutional framework for environmental management; financing mechanisms; and major environmental issues and opportunities. The Assessment highlights data inconsistencies, gaps, and needs, and the extensive list of sources provides an excellent starting point for anyone attempting to locate relevant environmental data.

The book is a demonstration of ADB's and ICIMOD's strong commitment to developing south Asia's environment knowledge base further, disseminating the information widely, and providing much needed environment assessment information to policy makers, researchers and development practitioners for the development of economically and environmentally sound ecosystems while improving living standards.