STATE OF THE ENVIRONMENT

NEPAL

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Ministry of Population and Environment
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Cover Photograph Poster showing ideal environment

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1. State of the Environment Report published by MOPE in 1998 was revised and updated by Independent Consultant Mr. S. R. Devkota in June 1999.
2. This report was revised and edited by Dr. Arzu Rana-Deuba in October 1999

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Foreword

Natural resource depletion and pollution are the major environmental concerns in Nepal. A vast majority of Nepali people depend on forest resources for firewood and fodder. Increase in the level of environmental pollution has resulted in poor health of the population. The environmental quality has been degraded further due to lack of environmental standards and their enforcement.

In realisation of these problems as well as the benefits of environmental management, His Majesty's Government (HMG) of Nepal has started the integration of environmental aspects in the socio-economic development process through policy initiatives, law enforcement, institutional strengthening and public awareness programmes. The Ministry of Population and Environment (MOPE) has initiated, *inter alia*, a number of activities including the development of environmental tools to address these problems. One of such recent initiatives is the banning of the movement of diesel-operated three-wheelers in Kathmandu Valley, Pokhara Sub-Metropolitan City and Lumbini - the birthplace of Lord Budda since the middle of September 1999. HMG has introduced the Nepal Vehicle Mass Emission Standard since 23 December 1999. HMG is also planning to prepare and implement a comprehensive Environmental Action Plan to improve the overall environmental quality and promote sustainable development.

The *State of the Environment Report* provides insights into the environmental condition of the country and the efforts made to minimise the impacts of environmental degradation. I would like to appreciate the contribution of the individuals who were involved in preparing this Report.

5 June 2000
Kathmandu

Shiva Raj Joshi
Minister of State

Preface

Nepal faces different kinds of environmental challenges and the need to address them is also urgent. As rural and urban environmental problems vary significantly, two sets of environmental instruments are required to be developed and implemented through participation of stakeholders. The Ministry of Population and Environment is, therefore, in the process of developing these instruments aimed at promoting environmentally sound and sustainable development.

As development of different projects have their impacts on the environment to a certain degree, it is necessary to inform development partners and people at large about the consequences of their activities on the environment.

With this understanding, His Majesty's Government of Nepal published the first *State of the Environment Report* on 5 June 1998. This Report is the second in series. This Report outlines the current environmental trends with an analysis of problems in socio-economic, physical and biological environment. The Report documents the existing policies, strategies, legal measures and other actions taken to address these environmental issues.

The Ministry will appreciate receiving the comments and suggestions from readers and shall consider them for inclusion in future publications of similar State of Environment Reports of the country.

The Ministry acknowledges the valuable inputs provided by Mr. S. R. Devkota, the then Member of the Environment Protection Council in reviewing and updating this Report and appreciates the efforts of Dr. Arzu Rana-Deuba for editing this Report. I would also like to express my thanks to colleagues of MOPE Messrs J. R. Joshi, Joint Secretary, M. P. Regmi, Legal Officer, P. Kunwar, Under Secretary and B. K. Uprety, Ecologist and Ms. Pinky Singh Rana of SAMANATA for their efforts in bringing out this Report in the present form.

5 June 2000
Kathmandu

Dr. Govinda Raj Bhatta
Secretary

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Summary

This **State of the Environment Report** presents sector-wise information on environmental dimensions, trends, policy initiatives and emerging issues at the national level. Primarily based upon secondary information, the Report also includes samples of some measures adopted for integrating environmental aspects into development activities.

Nepal can be divided into five physiographic regions with sharp contrasts in elevation and steepness, ranging from flat plains (below 100 m above the sea level) to the high Himalayas (Mt. Everest - 8,848 m). About 60 per cent of the total land can be graded as steep to very steep. The soil and climate also vary according to the physiographic zones. Such a diverse physiographic setting and the consequent varied ecological settings present both opportunities and complexities for environmental management.

In general, environmental problems have emanated from unsustainable use of natural resources, and inadequate integration of environmental planning into development programmes and their implementation. Major environmental problems have emerged from land degradation, depletion of forest resources, unplanned urban development and mismanagement of industrial effluents and domestic wastes.

Population growth has been one of the major causes of environmental degradation, as it increases pressure on the natural resources base. Rural-urban migration has also stretched the carrying capacity of urban utility services such as drinking water and sewerage systems. Water-borne and air-borne diseases are on the rise in towns and cities. Only about 30 per cent of the total population has access to piped water, and sanitation facility is accessed by only 7 per cent of the country's total population. Poverty has also been one of the lead causes of environmental degradation in Nepal.

Nepal's greenhouse emission level is insignificant as only 52 tons of Ozone Depleting Substances (ODSs) have been estimated utilised which corresponds to per capita consumption of only 0.0013 kg.

Environmental problems have also cropped up during the construction and operation of water resources projects. Withdrawal of underground water and low recharge potential, particularly in Kathmandu Valley is a potential threat for land subsidence. The physico-chemical and biological qualities of water are also degrading. Some wetlands are facing dual problems of eutrophication and encroachment.

Land use change is noticeable in forest and agricultural land. There is a tendency to cultivate marginal lands. Several studies have concluded soil erosion to be a major environmental concern for Nepal. In terms of land degradation, about 0.4, 1.5 and 11.7 per cent respectively of the total watershed is reported to be in very poor, poor and fair conditions respectively. It is also estimated that about 1.8 million tons of plant nutrients are removed due to crop harvest and soil erosion processes. Out of this, only 0.3 million tons are replenished by organic and mineral fertilisers, while the rest is permanently taken out of the soil thereby depleting the land productivity. Natural hazards such as landslides and floods are accelerated by human activities due to cultivation practices in the steep slopes and marginal lands. About 10,000 ha of land is typified by characteristics of cold desert.

About 50 per cent of Nepal's total area is covered by vegetation. Forest type differs from east to west and from north to south. However, there has been a steady decline in forest cover in almost all areas of the country. At present, only 4.2 million ha (29 per cent) and 1.6 million ha of the country is occupied by forests and shrub lands respectively. However, due to the success of community forestry programmemes, the quality of forests have improved in the hills and mountains. About 70 per cent of the population depend on the forests for their energy requirements. About 42 per cent of the total digestible nutrients for cattle are also obtained from forests. The Master Plan for the Forestry Sector state that there is a deficit in fuelwood, fodder and timber in specific areas, with the central mid-hills being greatly affected.

Nepal is rich in biological diversity. Though it has only 0.03 per cent of the total landmass of the world and 0.3 per cent of Asia, yet about 2.6 per cent of the flowering plants, 3.2 per cent of pteridophytes, 6 per cent of bryophytes, 8.5 per cent of birds, 4.3 per cent of mammals, and 1.5 per cent of reptiles of the world's flora and fauna have been recorded in Nepal thus far. About 500 species of plants are endemic to Nepal. Over 1,000 species are described from Nepalese flora. Of the total species recorded, 20 plant species are included in the CITES appendices and 13 species are legally protected. HMG has also given legal protection to 26 species of mammals, 9 species of birds and 3 species of reptiles. These species are conserved in 8 National Parks, 4 Wildlife Reserves, 3 Conservation Areas, and Hunting Reserve as well as other national and community forest areas. However, species outside the protected areas are facing threat due to habitat loss and/or degradation, unregulated collection of forest products, poaching and hunting of wild animals.

Energy demand is met from a combination of both traditional and commercial sources. About 89 per cent of the total energy is obtained from traditional sources such as fuelwood, agricultural residues and dung, while the remaining 11 per cent is obtained from commercial sources such as petroleum products, coal and electricity. There is an increasing trend to utilise commercial energy. Though Nepal's hydropower potential is high, thus far only 1 per cent of the

total energy need is met from this sector. At present, efforts are being made to promote alternative sources of energy. Government subsidies for biogas generation have increased its usage in the plain and the valleys of the country.

The volume of municipal wastes is increasing along with population growth. In Kathmandu Valley, over two-thirds of the waste is biodegradable and can be recycled and reused. However, hazardous wastes disposed-off mostly by the health institutions will likely to further compound the waste management problem. Existing facilities are grossly inadequate for safe collection, segregation, transportation and disposal of municipal wastes. A recent governmental policy of inviting the private sector to manage waste could possibly contribute to the reuse of waste material.

Emissions from vehicles and industries have led to significant changes in the quality of the urban atmosphere. Existing ambient air quality in Kathmandu Valley is within the range of the WHO guidelines, with the exception of total suspended particulate (TSP) and particulate matter (PM_{10}). Sporadic research findings indicate winter days to be more polluted than summer days, in terms of airborne particulate matter presence. Though the volume of wastewater is low, some of it is known to be highly toxic. In general, environmental pollution is location-specific and is on the increase due to disposal and/or discharge of waste and wastewater without any treatment. Noise level in the urban and industrial areas is also on the increase. It is likely be a major concern in a number of municipal and industrial areas in the near future.

In spite of increasing agro-inputs like chemical fertilisers and pesticides, there is no significant increase in the yield of major crops. Even now, 1.7 million hectares (ha) which accounts for 65 per cent of the total cultivated land is only rainfed. The yield rate of paddy indicates a slight increase from 1.98 mt/ha to 2.42 mt/ha, with significant variations, in between the period 1974/75 to 1998/99. The yield rate for 'maize' has decreased slightly while there is a marginal increase for wheat. In sum, the yield rate of principal food crops indicates slight increase with fluctuations in different years. The area under food cultivation has also increased by over one million hectares while the total production has gone up by 2.5 million tons. In case of livestock, the production is on the increase. Livestock density has increased from 5.95/ha in 1981/82 to 7.4/ha in 1991/92. Fishery production is also on the increase. Even though agriculture production has increased, its contribution to the gross domestic product of Nepal has decreased from 69 per cent in 1974/75 to 42 per cent in 1995/96 of Nepal. The agricultural sector will continue being one of the major sectors in the national economy as over 80 per cent of the people still depend on it. The inter-dependency of agriculture, livestock and forestry is conspicuous, especially in the mountains. Implementation of the Agriculture Perspective Plan (APP) is expected to increase the production of crops, livestock and fisheries.

Nepal is rich in cultural heritage. Eight cultural and two natural heritage sites (Royal Chitwan National Park, and Sagarmatha National Park) are included in the World Heritage List. Nepali community-based organisations are involved in conserving the local cultural sites. However, some of these cultural sites are facing threat from encroachment.

There is an increasing number of visitors each year and tourism is a major source of foreign exchange earnings. However, disposal of non-biodegradable wastes such as plastics, glasses, batteries in the mountain and trekking routes is an emerging environmental concern.

Governmental and non-governmental organisations are collaborating to create public awareness. Environmental programmes are regularly aired on radio and television. The print media is active in publishing on emerging environmental problems. These public awareness activities have contributed to the implementation of natural resource management programmes and pollution control. The government and the NGO sector is also involved in implementing social development programmes by implementing natural resource management activities in order to improve the living conditions of the people.

In order to address these environmental concerns, HMG has enunciated environment-friendly policies, developed and implemented action plans and introduced environmental legislation. Environment friendly provisions are included in sectoral legislation, which were enacted or amended after 1990. A separate Environment Protection Act (EPA), 1996 and the Environment Protection Rules (EPR), 1997 (amendment 1999) have also been enforced since June 1997. The EPA, 1996 contains several provisions for institutionalising environmental impact assessment as a planning and management tool and expanding pollution control activities. A number of institutions have also been established to implement activities for the conservation of the environment. HMG constituted an Environment Protection Council as a policy advisory body in 1992 and established the Ministry of Population and Environment in 1995. Some macro-economic policies are also being evolved to create an environment-friendly State so that sustainable development can be concurrently achieved. A few economic instruments are also in place to encourage different stakeholders to conserve environment effectively. For example, 30 to 50 per cent of the total revenue collected in the protected areas will be allocated to the local people living adjacent to such areas for community development. HMG has also provided 99 per cent tax exemption and VAT exemption for the import of microbuses in implementing the decisions on diesel-operated three wheelers.

Various location-specific programmes are under implementation through collaborative efforts. One such programme is the banning of the movement of the diesel-operated three wheelers in Kathmandu Valley, Pokhara Sub-Metropolitan City and Lumbini - the birth place of Lord Buddha. HMG has also

banned the registration of new two-stroke engine vehicles since the middle of September 1999 as a preventive action for pollution control. Furthermore, HMG has introduced the Nepal Vehicle Mass Emission Standard, 2056 since 23 December 1999.

Nepal has joined the international community in their initiatives for environmental management by being a Party to several Conventions. Some action plans have been prepared and some are under preparation to implement resolutions enshrined and agreed to by Nepal in the conventions.

However, in spite of instituting laws, policies and programmes, a number of environmental challenges still prevail. Poverty, population growth, rapid urbanisation still impacts the resource base and cause environmental pollution. Therefore, a more concerted effort is required to curb this trend of environmental degradation and progress towards a more sustainably development country.

Chapter One
INTRODUCTION

NEPAL plans for progressing towards sustainable development with economic liberalisation policies along with environmental management. His Majesty's Government (HMG) is taking aggressive steps to ease serious constraints to development, accelerate growth and alleviate poverty. The role of the private sector is viewed as being crucial for economic development and creation of employment. However, the government recognises that during the process of economic and infrastructure development, environmental issues must not be neglected o overlooked. Without due incorporation of environmental issues in development planning and implementation there is a high possibility of degrading human and physico-biological environment.

Environment is understood as a complex dynamic system of living and non-living entities of a particular area, where each component of the system interacts with each other and leads to a change in its quality and quantity. Since environment is multifaceted, multi-disciplinary and multi-sectoral in character, complexities of environmental problems in the country are, directly or indirectly, an outcome of development policies and programmes. In order to understand the causal links and establish linkages between the environmental and developmental activities, various countries prepare the State of the Environment (SOE) Report. The SOE describes prevailing conditions from two perspectives - biophysical and socio-economic. A general picture of how human activities impact the environmental conditions, the human health and the economic development are also presented therein.

Primarily based upon secondary information, this report is designed to describe the national state of environment in diverse sectoral areas in the format approved by the Conference of the Fourth SAARC Environment Ministers held at Colombo from 30 October to 1 November 1998. It addresses relationships between different development activities and their impact on the environment. The report also encompasses the prevailing environmental conditions, illustrates the current environment friendly policies as a basis for integrating environmental aspects into developmental activities, and describes emerging environmental concerns.

Current environmental issues in Nepal which have emerged from ongoing land degradation, depleting forest resources, unplanned urban development, discharge of untreated effluents and disposal of wastes

brought on by inadequate consideration of the environment in development planning have also been discussed herein. The existing opportunities for effective implementation of environment friendly policies to redress the environmental problems are also discussed in this report. This report strives to provide a foundation for future environmental policies and programmes.

1.1 Physiography

Nepal is roughly rectangular in shape. The country's landmass stretches 885 km from east to west and has a non-uniform width of 193km north to south. It has a total land area of 147,181 sq. km and an estimated population of 21.84 million in 1998. It lies within the sub-tropical to the mountainous region at 26°22' to 30°27' N latitudes and 80°4' to 88°12' E longitudes, with an altitude that ranges from 90 m to 8,848 m. The country is landlocked and is bordered by India in the East, West and South, and China in the North.

Nepal is ethnically diverse. It is home to several race, tribes, languages and religions. The Nepalese population consists of Indo-Aryan and Mongol races. Two major religions, Hinduism and Buddhism, have moulded the country's cultural fabrics. Administratively, Nepal is divided into 5 development regions, 14 zones, 75 districts, 58 municipalities and 3,912 Village Development Committees (VDC).

Geographically, Nepal represents a transitional mountain area between the fertile Gangetic Plain of India and the arid plateau of Tibet, China. The country is rich in ecological diversity with slightly over 80 per cent of the land covered by rugged hills and mountains. From the low-lying Terai plains in the south, where elevation in some places is less than 100 m above sea level, the landscape rises through a maze of valleys and spurs culminating in the majestic heights of the Great Himalayas, including the Mount Everest - the highest peak in the world.

The narrow strip of flat alluvial terrain along the southern border, known as the Terai, is an extension of the Gangetic Plain and comprises about 14 per cent of the country, including most of the fertile and forest areas. Its general slope towards the south is less than 1 per cent. The Churia and Mahabhrat Ranges punctuate the Terai plains with an approximate width of 50 km. The elevation ranges from 60 m to 330 m above sea level (Table 1.1) and constitutes the most productive agricultural region of the country, with a good potential for the development of agro-industries. Its northern edge is the Bhabar, which is characterised by boulders and freely drained gravely soil. This area is unsuitable for agricultural purposes.

The first elevation next to the Terai is the Siwaliks (also known as Churia Range), which covers about 13 per cent of the country. Their average altitude is 900 m (elevation difference from 120 m to 2,000 m) and is about 8 to 10 km in width. The Churia range is the youngest member of the Himalayan family and has dry and immature soil. There are a number of Terai-like valleys lying between the Siwaliks and the Mahabharat range, commonly called the Dun Valleys (inner Terai plains), such as Chitwan and Dang.

To the north, running parallel with the Churia range is the Middle Mountain Zone, also known as the Middle Hills or the Mahabharat Range. The altitude ranges from 500 m in low-lying valleys to over 3,000 m. This maze of valleys and spurs has been the traditional zone of human occupancy in Nepal. It is extensively cultivated and pressure of population on these lands is high.

The Middle Mountain Zone constitutes the traditional and cultural heartland of the country. The total area equals approximately 30 per cent of the country and is typified by extensive terraces, large numbers of landslide scars, as well as tracts of eroded land. The Mahabharat girdles Kathmandu Valley - the capital of Nepal, a geologically structured trough with an average altitude of 1,300 m. This Valley has long remained the jewel among the Nepalese hills. The Valley is endowed with deep, fertile, lacustrine soil and was nurtured as the focal point for trade between Tibet and India until the end of the last century. The rapid rise in population, and consequent problems of ecological degradation have been the most conspicuous feature of this hill region in the recent years.

The High Mountain Zone, located north of the Middle Mountain Region, covers about 20 per cent of the country. It is characterised by long, straight and steep slopes, and narrow valleys which are sensitive to erosion. Few areas are cultivated and the productive capacity is comparatively low.

The High Himal Zone occupies about 23 per cent of the Kingdom and is mostly snow covered. The snow line is at 5,000 m in the East and 4,000 m in the West. This zone is an area of rocky, ice-covered massifs, rolling uplands, snow-fields, valley glaciers, and sweeping meadow lands. It forms the northern boundary of the monsoon climate and the geo-political border between Nepal and China. This region has over 200 peaks exceeding 6,000 m. Eight of the ten highest peaks exceeding 8,000 m on earth, including the Mt. Everest (8,848m.), are located in this zone.

Table 1.1 **Land Systems by Physiographic Regions of Nepal**

Physiographic Regions/ Elevations	**Land Forms**	**Climate**
High Himal Region (>4000 m.)	Alluvial, colluvial and morainal depositional surfaces. Steep to very sloping mountainous terrain.	Alpine and Tundra
High Mountain Region (2200 - 4000 m.)	Past glaciated mountainous terrain below upper altitudinal limit of arable agriculture.	Warm to Cool temperate
Middle Mountain Region (500–3000 m.)	Ancient lake and river terraces (Tars-elevated plains) (erosional). Moderate to steep mountainous terrain. Steep and straight mountainous terrain.	Warm temperate
Siwalik Region (120-2000 m.)	Active and recent alluvial plains. Fans, Aprons and ancient river terraces (Tars). Depositional basin (Duns). Moderate to steep to very steep hill and mountainous terrain.	Sub-tropical
Terai Region (60 - 330 m.)	Active and recent alluvial plains (depositional). Alluvial fan apron complex (erosional).	Sub-tropical

Source: CBS, 1994

The geological formations correspond to the physiographic zones. The Siwalik is made up of sedimentary deposits. Schists, gneisses and granites are the major rock types in the mountainous regions. The mountains are geologically young and still rising.

There is also a sharp contrast in elevation and steepness of the terrain. About two-fifths of the land surface lies between 305 m to 1,524 m, 22.6 per cent lies between 1,524 m and 3,048 m, 27.5 per cent above 3,048 m and 11.3 per cent below 305 m of the total land surface (HMG, 1992). In terms of slope, 58.7 per cent of the land is steep to very steep in between 20 to 35 degrees (Siwaliks and Middle Mountain Zone), 21.7 per cent of the land has moderate to steep slopes, 13.6 per cent has less than one degree sloping - mostly in Terai, while the remaining area (4.6 per cent) is either gently sloped or dissected (1.4 per cent).

Soil type also differs in the physiographic zones. In the Terai, the soil is alluvial and usually fine textured, with good water-holding capacity. In the Siwaliks, the dominant soil texture is sandy with pebbles. These soils are poorly developed and prone to erosion, and cannot retain high-intensity precipitation. In the Middle Mountains, the soil type varies from medium to light textured coarse-grained sand, which is also prone to erosion. The upper region also consists of hard rocks in many places.

1.2 Climate

Nepal lies within the subtropical monsoon climatic system. Due to its varied topography there is a wide climatic variation. With altitude being a guiding factor in climatic classification, five different types of climates are present in Nepal. They include sub-tropical monsoon, warm and cool temperate, alpine, and tundra climate. The Terai and the Siwaliks experience subtropical climate, while the northern mountainous regions have cold, dry continental and alpine winter climate. The main source of precipitation is the summer monsoon (late June to September) of which 80 per cent falls during this period, 15 per cent during the post-monsoon (October) and pre-monsoon seasons (April to May), and the remaining 5 per cent during the winter (November to February) periods. The precipitation varies from place to place and ranges from 250 mm to over 5,200 mm per annum. The Lumle area (western region near Pokhara) receives about 5,000 mm, whereas Mustang, Dolpa, Manang and the intra Himalayan high basins receive less than 500 mm of precipitation a year. In general, the topographical orientation and its vertical extension largely affect the distribution of rainfall in Nepal. As one proceeds towards the northern part of the country the temperature also varies according to the physiographic zones and the temperature starts declining.

The climatic and physiographic conditions generate environmental problems such as soil erosion and landslides. Loss of nutrient rich topsoil in the uplands affects the downstream ecosystem and the farmlands, indicating a close link between the uplands and the lowlands. This problem, partly natural in character, is further accelerated by human activities. This indicates that any problem in the uplands will have cumulative effects on the people living in the plain areas. The following chapter illustrates the changes in environmental resources over a period of time in various sectors.

Chapter Two
ENVIRONMENTAL TRENDS

Environmental challenges are emerging in an unprecedented manner with equal and ample opportunities to improve the environmental quality. This Chapter II presents the trends in changes of environmental quality over the time period.

2.1 Human Dimension

2.1.1 Population Growth and Urbanisation

The Population Census was conducted for the first time in Nepal in 1911. This census recorded a total of 5.639 million people in Nepal. Until 1930, the population was observed to be declining. From 1941 onwards, a decade-wise population census was initiated and the total population was recorded to be only 6.284 million with the annual growth rate of 1.16 per cent and a doubling time of 60 years. Statistics revealed the population growth rate from 1971 onwards to be 2.07 per cent. The present trend of annual population growth has declined from 2.66 until 1981 to 2.1 per cent in 1991. Recent population projection has estimated a total of 23.450 million people by the year 2001. With a growth rate of 2.66 per cent and 2.37 per cent, doubling time of the population will be only 26 and 29 years respectively. The population in the Terai increased from 43.6 per cent in 1981 to 47.9 per cent in 2001, while in the Mountains and the Hills the population has decreased (MOPE, 1999).

Population distribution in the physiographic zones and the development regions greatly differ. The population density was 126 people/km^2 in 1991, which has been estimated to reach 159 people/km^2 in 2001. The crude birth rate also dropped from 41.6 in 1991 to 37 in the period of 1994-96, with the Mountains having the highest fertility rate of 6.6 (Box 2.1). This disproportionate population distribution could be attributed to unequal distribution of resources, difficult topography, disparity in income and social development, and inadequate basic facilities.

The size of absolute population has increased considerably. If the present trend continues it is likely that natural resources will be depleted at an unprecedented rate. Population growth has both, positive and negative implications in resource conservation and it is uniformly distributed among all the regions and/or districts. The social, economic and natural conditions of districts also have a wide degree of variation. Accham, Humla and Mugu

districts have the lowest development indicators and are poor in terms of natural resources, women's empowerment, infrastructure development, and poverty.

Figure 1. **Population Size and Growth Rate in Nepal**

Vital Statistics - Population

Box 2.1

Particulars	**Year**	
	1991	**2001***
Total Population (Million)	18.49	23.450
Male (Million)	9.22	11.714
Female (Million)	9.27	11.738
Crude birth rate (per thousand)	41.2	33.06
Crude death rate (per thousand)	13.3	9.62
Total fertility rate	5.6	4.2
Infant mortality rate (per thousand live birth)	97.5	61.5
Life expectancy rate	54.3	59.66
Per day population increase		1,506

Source : MOPE, 1999 and Dangol, 1999.
Note : * Estimated

Rural-urban migration has increased the urban population due to increasing economic activities in the latter. In 1961 the urban population was only 3.6 per cent of the total population, and it increased to 9.2 per

cent in 1991. Despite the paucity of basic urban services, it is expected to reach to 3.4 million by the turn of this century (Dangol, 1999). For instance, only about 71 per cent of urban households in Kathmandu have water supply connections. Similarly, access to water supply is approximately 39 per cent in Pokhara, 21 per cent in Biratnagar and 10 per cent in Bharatpur. Similarly, about 25 per cent of households in Kathmandu are connected to sewerage facilities, whereas in other municipalities such services are virtually absent. The National Shelter Policy of 1996 identified housing blocks in Nepal to be in vulnerable condition. There exists about 3 million residential houses (2.7 million houses in rural areas), out of which 50.5 per cent houses are *Kachha* (temporary), 41.2 per cent houses are semi-permanent and 8.3 per cent are permanent. Annual increment rate of houses in urban area is estimated at 5.5 per cent, while in rural area it is less than 2 per cent. At the national level, urban population growth rate increased from 3.23 per cent in 1971 to 5.89 per cent in 1991 (MHPP, 1996). As the number of municipalities has reached 58, the urban population is estimated to have reached about 14.8 per cent of the total population.

Population growth has a constant pressure on natural resource base such as forests and land. The concentration of people in the hills has increased the cultivation of marginal lands, overgrazing, and illegal collection of forest products. Meanwhile, rapidly growing urban areas are affected by the shortage of basic utility services, resulting to the degradation of environmental quality.

2.1.2 Health and Sanitation

A steady improvement in the health status of people is reflected by the steady decline in the infant mortality rate (IMR). Between 1950 and 1954, the IMR was 197 per thousand, which dropped to 156 per thousand in the 1970s and further declined to 97 per thousand by the year 1991. The latest survey indicates a further decline of IMR to 93 per thousand in 1994 (MOH, 1996). The number of hospitals, nursing homes, health centres and health posts have also increased. Progress in health status has been attributed to the joint efforts of the government and private sector. Indirect intervention programmes such as non-formal education, and income-generating activities have also played an important role in improving health conditions. Life expectancy has significantly increased from 27.1 and 28.5 for male and female respectively in 1954 to 55.0 and 53.5 in 1993 (MOPE, 1997). This is due particularly to the increased health service facility, preventive methods such as child and mother immunisation activities, and use of oral rehydration therapy.

Overall, 43 per cent of children aged between 12 and 23 months are provided with the recommended vaccinations, while 36 per cent of them have vaccinations before their first birth day. Yet, one out of the five children aged between 12 and 33 months is not vaccinated at all (MOH, 1996). Vaccination coverage has increased from under 25 per cent in 1985 to over 37 per cent a decade later, indicating an improvement in its coverage. However, it is still far from the stipulated goal of 90 per cent coverage by the year 1995, as articulated in 1991.

Prevalence of stunted growth is very high, as stunting has been seen in 48 per cent of children under the age of five, with 20 per cent being severely stunted (MOH, 1996). The prevalence rate of stunting rises as high as 64 per cent among children between 24 and 35 months. A national level maternal nutrition survey reported 25 per cent of mothers facing chronic energy deficiency based on the Body Mass Index (BMI) of assessment (MOH, 1996). The nutritional level and prevalence of diarrhoea are associated with sanitary conditions of individuals, families and communities. The state of sanitary facilities in Nepal is presented in Table 2.1.1. Nepal Multiple Indicator Surveillance (CBS, 1996) reported that 41 per cent of the community members perceived no problem related to water supply, 27 per cent perceived distance as a problem, while 19 per cent perceived the problem of pollution of the water sources.

In spite of various efforts for development of health and sanitation facilities, a number of people are suffering from different types of diseases. Cases of gastro-enteritis, hepatitis, dysentery, respiratory diseases, and health-related problems are on the increase, indicating inadequate implementation of environmental pollution control measures. However, the number of death due to water-borne infections has comparatively declined over the years. For example, about 6,000 cases were registered and the death of 157 patients were recorded in 1988/89, whereas in 1995/96, the number of cases reached to 6,682 and the recorded death declined to 105 (CBS, 1997).

According to the Living Standards Survey - 1996, nearly 41 per cent households in the country are within 30 minutes walk's reach of the nearest health agency. HMG/N is committed to establish a sub-health post in each VDC, and thus almost 3,200 sub-health posts have so far been established. However, people are still prone to malaria, *kalazar* and encephalitis in 64 districts. Under the polio eradication scheme, approximately 3.3 million children under the age of five have been vaccinated.

Table 2.1.1 **Drinking Water, Sanitation and Health Services**

SN	Description	Per cent of People Served
A	**Source of Drinking Water**	
	Piped water	31.5
	Well water	7.1
	Hand pump	31.9
	Spring water (Kuwa)	18.9
	River/stream	7.2
	Others	3.4
B	**Sanitary Facility**	
	Having toilets	22.5
	No toilets	77.5
C	**[x]Population with Access to**	
	Health services	15.0
	Safe water	42.0
	Sanitation	6.0

Source: MOH, 1996 and [x]MHPP. 1996

Table 2.1.2 **Public Health Achievement in the Eighth Plan Period (1992-'97)**

	Target	Progress
Total fertility rate	4.5	4.58
Family planning services to couples	12,46,800	12,62,523
Users of family planning devices %	32	30.1
Services to pregnant women and delivery cases	17,04,000	8,33,951
Women health volunteers	63,000	46,427

Source: NPC, 1998. Ninth Five Year Plan.

2.1.3 Poverty Implications

Population growth and decline in farm production has intensified land use change in the country. Conversion of marginal land to cultivated land is on the increase. High human fertility, high mortality rate and high agricultural disguised labour force prevail in the rural areas. These, added with inadequate employment opportunities are likely to have an increasing negative effect on poverty.

The Human Development Index (HDI) value for Nepal is 0.463 on an international scaling. This is based on the life expectancy, access to heath services, food and nutrition, education, income, status of children and women, and out of 175 countries Nepal is listed 144th (UNDP, 1997). The report further revealed a wide difference in income distribution. The per

capita real GDP based on purchasing power parity (PPP) for the year 1994 was US$ 1,090 with the difference between the GDP and HDI rank for Nepal being 11 at international scaling.

There is also close inter-linkage between population growth, resource depletion, environmental degradation, and low level of social development. The cumulative effect is the increasing extent of poverty which is both a cause and effect of environmental degradation (EPC, 1993). Poverty alleviation was one of the major objectives of the Eighth Plan and was targeted at reducing the population below poverty line, from 49 per cent to 42 per cent by the end of Plan period. The poverty situation over the past two decades is indicated in box-figure (CBS, 1998). On the other hand, average GDP growth indicates a steadily increasing trend since the 1960s (Table 2.1.4). Estimated per capita GDP for the year 1998/99 is US$ 222 only (CBS, 1999).

Figure 2. **Poverty Estimates by Area of Residence**
Source: CBS, 1998

Table 2.1.3 **Profile of Human Poverty**

People not expected to survive to age 40 (as % of 1990 population)		19.9
Adult illiteracy rate (% 1995)		72.5
Children not reaching grade 5 (% 1990-95)		48
Refugees by country asylum (x1000, 1995)		124.8
Population in poverty (US$ 1 a day PPP) (%) 1994		53
Daily calorie supply per capita (1992)		1957
Labour force (as % of total population 1990)		47*
Labour force increment (1990-95) (%)		2.4*
Female labour force (%) (1995)		40*
Distribution of Gross Domestic Product (%)*		
	1980	**1995**
Agriculture value added	62	42
Industry value added	12	22
Manufacturing value added	4	10
Service value added	26	36
GDP (million US$)	1,946	4,232

*Source: UNDP, 1997; * World Bank, 1997*

Various policies have been enunciated to reduce population growth, increase agriculture productivity, and expand off-farm employment opportunities. However, poverty alleviation efforts have not changed the situation and there is an increasing trend of poverty.

Table 2.1.4 **Average Annual Growth of GDP in Different Plans**

Plan Period	**Overall**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Third Plan (1965-'70)	2.6	2.8	2.2					
Fourth Plan (1970-'75)	1.8	1.6	2.3					
Fifth Plan (1975-'80)	2.3	-1	8.8					
Sixth Plan (1980-'85)	4.9	5.1	4.7					
Seventh Plan (1985-'90)	4.8	4.1	5.3	4.9	6.4	5.2	5.2	6.9
Eighth Plan (1992-97)	4.6	2.8	6	7.1	3.9	7.6	5.7	6

Source: CBS, 1998

Note :1 = Agriculture sector, 2 = Non-agriculture sector, 3 = Manufacturing, 4 = Construction, 5 = Trade, = Finance, and 7 = Others

2.1.4 Social Services

Management of natural and man-made resources also depends on mobilisation of the social sector. Improvement of social facilities would contribute towards minimising environmental damage. Towards this

endeavour, policy and legal measures are focused upon environmental education, sanitation and health. However, this sector can not be developed without effective participation of the local people, i.e., the beneficiaries and victims of the environmental conditions. With this realisation, HMG formulated several policies and environmental instruments to facilitate the participation of different stakeholders, including the civil societies, in the development of the social sector.

Following the restoration of democracy in 1990, several non-governmental organisations have been established with the objective of implementing environmental activities. Most of these NGOs can be categorised as professional, social and indigenous organisations, while others are community-based organisations (CBOs). These NGOs are registered in the Chief District Office (CDO) under the Association Registration Act of 1978 and later with the Social Welfare Council. By 1996 the number of NGOs had crossed over 20,000. About 800 NGOs have also shown keen interest to collaborate with the Ministry of Population and Environment for the implementation of environmental activities, individually or jointly. Non-governmental organisations are also providing employment opportunities to people for initiating developmental and social welfare activities. CBOs have also gathered experiences in environment and development activities by involving in rehabilitation ponds, *guthi* operations for renovation of temples, etc. (Box 2.2).

Box 2.2

Chhatis Mauja Kulo of Bhairhawa (Western Development Region) provides an example of indigenous management of a scheme for irrigation facility effectively. Such management schemes in rural areas lead to the recognition and promotion of Farmers Managed Irrigation Schemes (FMIS) all over the country. The local people contribute financially towards repair and maintenance through their own efforts. Similarly, CBOs are also involved in the management of the natural resources such as forests, ponds and micro-watersheds

In addition, international NGOs (INGOs) such as Save the Children - USA/UK/Japan, CARE - Nepal, Oxfam, Plan international, etc. are also participating in social mobilisation vis-à-vis implementation of conservation activities. The World Conservation Union - IUCN, and the World Wildlife (WWF) are two international NGOs involved in the transfer of natural resource management know-how. In addition, some donor agencies such as GTZ, DANIDA, FINNIDA, SNV, ODA, JICA, USAID, UN agencies, WB and ADB and are also addressing environmental issues through their programmes.

In sum, Nepal experienced steady population growth rate, the population growth rate has not declined in spite of several population management efforts. The increasing population rate is not compatible with the carrying capacity of Nepal's natural resources endowment. Another critical issue is the imbalanced distribution population access to natural resource. Some districts, especially, the least developed mountain regions, have a declining population size while others have a high growth rate. However, health indicators such as infant mortality and life expectancy rate have steadily improved. The coverage of health services such as immunisation programmes, oral re-hydration therapy and nutritional programmes have also considerably increased.

Yet, 50 per cent of the total population still live below the poverty line. Increasing number of impoverished people have multi-fold negative environmental impacts, particularly on the natural resource base such on as soil, water and forests. In order to improve socio-economic and environmental conditions, HMG is encouraging social organisations to participate in community development activities. Though, social mobilisation through social organisations is not a new phenomenon and has been in practice for centuries, the cumulative effect of these organisations on environmental management is yet to be evaluated.

2.2 Atmosphere and Climate Issues

2.2.1 Greenhouse Gases

The combustion of fossil fuels, deforestation and land use changes are two major sources of greenhouse gases (GHGs). Major sources of GHGs in relation to land use and soil borne sources are carbon dioxide, methane and nitrous oxide. During the period of 1960/61 to 1990/91, the general input of Carbon Dioxide due to deforestation and land use change in Nepal, was estimated at 6.9 x 10^{12} grams/year (Haughton et al., 1987), 3.96 x 10^{6} tons/year (Hall and Uhlig, 1991), and 8.34 x 10^{7} (min.) to 15.45 x 10^{7} (max.) tons/year (Devkota, 1992). These differences are basically due to the variation in the consideration of the forest areas. On the other hand, annual emission of GHGs through utilisation of petroleum products is estimated at 72 Gigagram (Gg) of Carbon, and 1.79 Gg of Nitrogen in between 1970/71 to 1990/91 (Devkota, 1992). Boden, Marland and Andres (1995) derived the trend of CO_2 emission in Nepal by utilisation of fossil fuels since 1950 to 1992. They estimated an emission of 354,000 tons of CO_2 emission in 1992 due to combustion of fossil fuels. Release of GHGs from other sources and its impact on the environment is yet to be analysed.

2.2.2 Chlorofluro Carbon (CFC)

In 1999, under the co-ordination of the Nepal Bureau of Standard and Metrology (NBSM), the Ministry of Industry endorsed a national programme to check CFC-12. According to a survey conducted by NBSM in 1996, a total of 52 tons of CFCs-12 (29 tons) and HCFCs-22 (23 tons) have been utilised in Nepal and the per capita consumption of Ozone Depleting Substances (ODSs) is only about 0.0013 kg. ODSs are utilised in Nepal in commercial refrigeration, building and air conditioning, and household refrigeration.

Although Nepal does not produce ODSs, the consumption rate is definitely on the increase. Inadequate control measures will likely increase the consumption of CFC-12 and it is predicted to reach to 85 tons by the year 2010.

2.3 Inland Waters

2.3.1 Water

Water is one of the major natural endowments of Nepal. The country has more than 6,000 rivers with considerable flow variation, sediment loads and deposition. Hydropower potential is estimated at 83,000 MW, of which 50 per cent is considered economically feasible. The annual mean stream flow for the snow-fed major river systems is estimated to be about 4,930 m^3/sec. This amounts to 70 per cent of the total annual surface runoff. About 60 to 85 per cent of the annual surface runoff occur during the monsoon period. The annual runoff from Nepal is about 222 billion m^3/sec, with a mean runoff coefficient of 0.777 (JICA/DHM, 1993; Table 2.3.1). Inter annual discharge variation is very high in the Nepalese rivers. The coefficient of annual variation is significantly higher in the rivers originating from the Middle Hills and the Churia than that of snow-fed rivers.

The Terai comprises a reasonable amount of groundwater resources for irrigation and drinking water purposes. A substantial amount could also be used for operating water-demanding industries. The water table is generally about 15 m from the surface in the northern part of the Terai, while in the southern parts it is closer to the surface. The middle section of the Terai, comprises of high-pressure artesian areas. The surface water table in Eastern Terai region varies from 3 to 4.5 m in general, while it changes from 3 to 9 m in the Dun Valleys of Central Terai, and up to 18 m depth in the Bhabar zone in the Western Terai. In Kathmandu Valley, the water table ranges from a depth of about 1 to 12 m and has limited number of aquifers which have been reported at about a depth of 450 m.

Table 2.3.1 **Estimated Runoff of the Rivers**

			Drainage Area in km		Estimated Runoff in m^3/sec	
SN	**River**	**Length (Km)**	**Total**	**Only in Nepal**	**From all Basins**	**From Nepal Only**
1.	Mahakali	223	15,260	5,410	730	260
2.	Karnali	507	44,000	41,550	1440	1360
3.	Babai	190	3,270	3,270	95	95
4.	West Rapti	257	6,500	6,500	160	160
5.	Narayani	332	34,960	30,090	1820	1570
6.	Bagmati	163	3,610	3,610	180	180
7.	Sapta Koshi	513	60,400	28,140	1670	780
8.	Kankai	108	1,575	1,575	83	83
9.	Other Rivers		21,432	21,432	851	851
		Total	**1,91,007**	**141,577**	**7029**	**5339**
[i] Mean Specific Runoff (m^3/sec/Km^2)					0.0368	0.0377
[ii] Annual Runoff (billion m^3)					222	169000
[iii] Converted Effective Precipitation (mm/year)					1161	1189
[iv] Average Annual Precipitation in Nepal 9 mm/year)						1530
[v] Mean Runoff Coefficient						0.777

Source : JICA/DHM, 1993

Statistics on water balance reveals surplus water resources in four major basins - Koshi, Gandaki, Karnali and Mahakali. However, water shortages occur during the dry seasons in the five medium river basins and most small streams originating from the Siwaliks. Water balance studies of five rivers, namely, the Kankai, Bagmati, West Rapti and Babai have indicated water shortages during the winter season.

Both the surface and ground water are potential sources for increasing agricultural production in Nepal. The Agriculture Perspective Plan (APP) has also emphasised development of irrigation facilities to increase the cropping intensity. The APP has identified shallow tube well irrigation as one of the priorities for the Terai area. Based on the recharge rate in the Terai, it is estimated that the extraction and recharge ratio in the Terai is to the order of 10 per cent.

Use of ground water for drinking purposes is extensive in Kathmandu Valley. About 46 per cent of the water supplied in Kathmandu and Lalitpur is from underground sources. In 1999 when the total demand of water for Kathmandu and Lalitpur was 123.8 MLD, the total available supply was only 103.6 MLD. At present, drinking water required for Kathmandu Valley is 150 MLD, but the supply is only one-third of the demand during dry seasons and two-thirds in other seasons.

2.3.2 Water Quality

Sporadic studies on water quality indicate degradation in the quality of both river and drinking water. Such deterioration is not just limited to urban and riverside settlement areas. Drinking water in most rural parts is also experiencing biological contamination. For example, the Bagmati River, which drains the Kathmandu Valley, is highly polluted at different stretches and its water is unfit for human consumption. Based on water quality and biological features, this river is divided into four sections. They are: (a) a zone of good ecological condition from the source to Guheswori, (b) a zone of slightly polluted condition from Guheswori to the confluence of Dhobi Khola, (c) a zone of severe pollution from Thapathali to Chovar, and (d) a zone of pollution from Chovar downwards (Sharma, 1986; and NESS, 1995). A one-year water quality monitoring record of the Bagmati river indicates a high level of discharge and/or disposal of oxygen demanding wastes in the river. The concentration of biological oxygen demand (BOD) and chemical oxygen demand (COD) indicates an increase from October to March.

A monitoring study also revealed river water quality to be generally good along the riversides, with the exception of areas along the human settlements (Hoffman, 1994). Water quality to some extent is degraded due to lack of sewerage treatment. According to a report published by the Nepal Water Supply and Sewerage Corporation in 1997, only 26,141 households in Kathmandu have connection to public sewerage. The remaining houses discharge their sewage into septic tanks, latrines or directly into the river systems. The public sewerage pipe is also directly drained into both Bagmati and Bishnumati rivers.

The monthly average sediment load in major river systems is estimated at 1.131 g/L in Sapta Koshi, 1.434 g/L in Sapta Gandaki, and 0.988 g/L in Karnali (Ghimire and Uprety, 1990). The Tamur river has the highest annual suspended sediment load of 57.6 million tons (Sharma, 1997; Table 2.3.2).

In general, quality drinking water in the urban areas is scarce and most often contaminated. In Kathmandu the quality is inferior due to the presence of different contaminants such as coliform bacteria, iron and ammonia (NESS, 1995 and ENPHO, 1993). The amount of iron in the drinking water in some cases exceeds the WHO standard and high concentration of iron makes the water unsuitable for industrial and other household uses. This drinking water also contains high ammonia, which

may be attributed to the decomposition of organic matters such as sewage, animal waste, and biomass near the water sources. Chloride varies from moderately high to very high. Sodium and potassium ratio is also less than 10 per cent, which again suggests pollution from urban sources. Other pollution indicating parameters revealed excessive contamination of drinking water by urban pollution sources, particularly sewage and solid wastes (NESS, 1995).

Table 2.3.2 **Suspended Sediment Load in Some Rivers**

Rivers	**Annual Suspended Sediment Load (Million tons)**
Karnali River at Asarghat	16.6
Seti River at Bangga	20.9
Surada River at Daredhunga	0.41
Rapti River at Bagasoti	16.0
Rapti River at Jalkundi	14.4
Kali Gandaki at Setibeni	27.7
Trisuli River at Betrawati	4.0
Lothar River at Piplet	0.60
Bagmati River at Chobhar	0.86
Kulekhani Khola at Kulekhani	0.02
Tamor River at Mulghat	57.6
Kankai Mai at Maina Chuli	5.5

Source: Sharma, 1997

In general, irrigation and power development projects are affected by heavy sediment recessing load. Watershed degradation is a common phenomenon. Some common environmental problems are landslides and floods, degradation of forests and land in the watersheds, deposition of sediment in the canal system and the reservoir, and change in water quality.

2.3.3 Wetlands

About 0.731 million ha of land in Nepal is covered by wetlands, including water bodies, of different sizes and characteristics (Bhandari, Shrestha and McEachern, 1994). Wetlands are highly fertile and productive ecosystems.

Nepal's wetlands can be divided into five categories.

?? The trans-Himalayan wetlands comprising of lakes such as Rara, Tilicho and Phoksundo;

- The relatively shallow midland-mountain wetlands lakes such as Phewa, Begnas and Mai Pokhari;
- The lowland-tropical wetlands which are are seasonally flooded riverine flood plains, including Koshi Tappu;
- The human managed wetlands such as ponds, rice fields, *ghols*, etc.; and
- Artificial wetlands such as reservoirs, irrigation canals and sewage ponds.

In Nepal, wetlands provide a habitat to over 180 species of fishes and a number of water-dependent birds and other animals. About 190 bird species are considered water-dependent, of which 90 species are migrants, 66 species are residential, while the remaining 34 bird species are uncommon and rare resident species (Manandhar and Shrestha, 1994). Of the 370 species of mammals, birds, reptiles, fish and higher vertebrates dependent on wetland habitats, about 100 species are estimated to be threatened (Suwal, 1992), while the Ganges river dolphins (*Platanista gangetica*) and gharials (*Gavialis gangeticus*) are considered vulnerable (Shrestha, 1995). Wetlands are also rich in aquatic angiosperms. They provide food for human beings, fodder for wild animals and ungulates, and feed for bird species.

The Koshi Tappu Wildlife Reserve (175 sq. km) is the only protected wetland and designated Ramsar Site in Nepal. This is the main habitat of wild buffaloes (Arna) (*Bubalus bubalis*) including about 325 species of birds.

Nepal's wetlands are facing degradation primarily due to eutrophication. They are critically threatened by the effects of anthropogenic activities such as deforestation, unregulated hunting, increased pollution level from the discharge of untreated effluents and damming.

In sum, adequate amount of surface water is available in different parts of the country. This could be used for drinking, irrigation, and hydro-electricity generation purposes. According to Hindu mythology, rivers are holy places that deserve both conservation and sustainable use. However, excessive withdrawal of underground water is exceeding the recharge rate, which is an environmentally unsound practice. Water pollution, of both drinking water and river, is increasing due to discharge of untreated effluents from industries and domestic sources.

Species inhabiting the Nepali wetlands are threatened by the destruction of their habitat. Eutrophication combined with encroachment has reduced the

area of wetlands, thereby, endangering various biological species inhabiting the area. In order to utilise existing resources on a sustained basis, a hydrological information bank should be established for planning and designing water projects. Environmental and social assessments should be integrated into project cycles, which would help optimise project benefits and minimise negative environmental impacts on wetlands. Due attention should also be given to minimising the volume of pollution load in water bodies through enforcement of environmental standards.

2.4 Land Degradation, Desertification and Natural Disasters

2.4.1 *Land Use*

Land resource base supports the livelihood of the majority of people. The great diversity in landscapes and climates is reflected in the complex usage of land. In general, land use category includes agriculture, forest, and pasture, snow cover and other lands. In the mid-1980s, agriculture, forest, Himali area, grazing area, water bodies, settlements and roads, and others (barren land, landslide, etc.) covered 18.0, 37.6, 15.3, 13.4, 2.7, 0.7 and 12.3 per cent respectively (NPC, 1985). However, they were later broadly divided into cultivated, grass, forest and shrub lands. Major portion of the land area is under forest cover, followed by agriculture (Table 2.4.1). This indicates an increase in agriculture area by 3 per cent, and a decrease in grassland area by 1 per cent while a separate shrub land category has also been identified. It also indicates that around 54 per cent of the total area falls under some form of vegetation cover in the wild.

A recent study on forest area concluded that only 39.6 per cent of the total area is covered by forests (29 per cent) and shrub land (10.6 per cent) (MFSC, 1999). The area over 4000 m altitude totals to 22.6 per cent of the total area of the country.

Table 2.4.1 **Land Use Pattern**

('000 ha.)

SN	Land Use	Total	Per cent
1	Cultivated Land	3,052	21
2	Non-cultivated Land Inclusions	998	7
3	Grass Land	1,745	12
4	Forested Land/ Forest Plantation	5,518	37
5	Shrub Land/ Degraded Forest	706	5
6	Other Land	2,729	18
	Total	**14,7484**	**100**

Source : HMG/ADB/FINNIDA, 1988

The land use distribution pattern indicates cultivated land to be concentrated in the Terai and the Middle Mountains in the Eastern, Central and Western Development Regions, while forestland falls in the High Mountains, the Middle Mountains and the Siwaliks. Shrubland is present in all physiographical regions.

There is increasing pressure on different land uses, particularly the forests and the grazing lands. The land Resource Mapping Project (1986) has identified the possibility of land use changes based on land capability. For example:

- In the Terai, the land capability analysis shows that forests are occupying good agricultural land.
- Throughout the mountains and hills, a large part of the land currently under agriculture is more suitable for forestry purposes.
- In the country as a whole, there are more degraded grazing and shrub lands and the forests have been converted to shrub lands.

Land use changes have occurred from both natural processes as well as human activities. Decline in agriculture production resulted in cultivation of marginal land. Land degradation process is also intense in different land uses. About one-third of the total area has either little vegetation cover or is totally devoid of it, while two-thirds of the country is geologically fragile. The man-land ration is comparatively high and soil erosion is pronounced in the Middle Mountains. As part of subsistence living, the vegetative cover is replaced by annual crops, and with the same scenario repeating itself the rate of soil loss is also accelerating.

2.4.2 Soil Erosion

Soil loss is more apparent than mass wasting in the mountainous region. Loss of topsoil by surface erosion is a direct result of heavy rains pounding unprotected soils. Some human activities also cause the soil to become more degraded than it would otherwise be in its natural condition. An increasing proportion of the soil loss is attributable to surface erosion induced by the increased dependence of people on limited land resources. Forest depletion, overgrazing, poorly maintained marginal land and fire have greatly altered the natural vegetation, leaving the soil open to degradation. Loss of one or two millimetres of topsoil every year from terraces may not make spectacular visual impact, but the cumulative effect leads to the impoverishment of the soil base. Similarly, the high rate of sediment transportation also impairs the water quality. Top soil, lost from the mountain, is raising the riverbeds in the Terai at an estimated annual

rate of 15 - 30 cm, increasing the incidence of floods and damaging and reducing the utility of fertile lands, irrigation channels, dams and hydropower projects.

Throughout the hill regions, soil loss from cultivated and grazing land are a major factor in declining soil fertility. Several studies have indicated two broad groups of soil loss namely those with soil loss below 5 t/ha/yr. and those without loss greater than 5 t/ha/yr. Soil loss in undergraded forest areas tends to fall below 1 t/ha/yr. as against in more degraded areas, wherein it is over 4 t/ha/yr.

Soil erosion in cultivated lowland (*khet* land) is comparatively lower than in rainfed terraces (*bari* land). The most sensitive period for soil loss in *bari* land is May, after the land is ploughed and prepared for maize cultivation. This again occurs in August-September following the maize harvest. In *bari* land gross soil loss is considered to be close to a maximum tolerable level of about 10 t/ha/yr. in weak to average monsoons.

In sum, soil loss differs greatly in different land uses. Regenerating forest with good levels of ground cover (at least 80 per cent) limits the soil loss, while rainsplash is responsible for much of the soil detachment on exposed and non-crusted surface areas. Ploughed land in the pre-monsoon period is particularly susceptible to high soil loss during high intensity and usually low frequency rainfall events.

At present, in terms of land degradation, about 0.4 per cent, 1.5 per cent and 11.7 per cent of the watersheds are reported in very poor, poor and fair conditions, respectively (Wagley, 1997). It is also estimated that about 1.8 million tons of plant nutrients (N, P_2O_5, K_2O and Ca) are removed by crop harvesting (0.5 million tons) and the soil erosion process (1.3 million tons) (Joshy *et al*., 1997). Out of this, only 0.3 million tons (16 per cent) are replenished by organic and mineral fertiliser sources. Problems of acidification, alkalisation and salinization have also been reported. These all have cumulative effects on farm production.

2.4.3 Desertification

Nepal's Himalayas are geologically young and fragile. The Himalayan ecosystems are vulnerable and even a low level of human intervention can lead to soil erosion and landslides. The scale and dimension of land degradation in the mountains has also been aggravated by their ecological sensitiveness, fragility, and other natural disturbances, leading to land further degradation.

Although Nepal has no desertitification problems in the form of dry lands, land degradation is severe and its productivity is also declining. The available statistics reveal that about 10,000 ha in Dolpa and Mustang - highlands in West Nepal - features a process of desertitification, particularly in the form of cold deserts or the symptoms of *brown cancer*. The cold desert has been spreading along with human intervention on the marginal lands.

In order to address these problems, soil and water conservation programmes and community forestry programmes have been implemented in many parts of the country through integrated and participatory approach (Wagley, 1997).

Nepal has joined the international movement to combat desertitification by ratifying the UN Convention to Combat Desertification in 1996 and this Convention has entered into force in Nepal since January 1997.

2.4.4 Natural Hazards

About 75 per cent of all landslides in Nepal are natural (Laban, 1979). This high rate of natural erosion is possibly due to the frequent tectonic uplifting of the major mountain ranges and consequent down cutting of the river systems, which result in unstable slopes. Mass wasting is also caused by rock failures, landslides, riverbank cutting and gullying. The instability is natural and the effect of man's activities on erosion process is incidental.

One of the most spectacular geomorphic events was the glacial lake outburst flood on Seti Khola in the Pokhara Valley. Around 600 years ago, a 10 sq. km lake behind Mount Machhapuchhre broke through its ice-moraine dams and surged down the Seti gorge, picking up colluvial debris as it proceeded. In a relatively short period of time, over 5.5 cubic kilometres of glacio-fluvial material was deposited in the Valley (Fort and Freytel, 1982; Yamanaka, 1982). As the Main and Central Boundary Thrusts cross the entire country, Nepal also experiences frequent earthquakes. A large number of landslides also occur during the monsoon seasons due to slope instability. Events of landslides and earthquakes are presented in Annex 1 (Sharma, 1988).

Natural and human-induced disasters have greatly affected the country's infrastructures. Road destruction from heavy rain and floods during the monsoon caused more than 2.5 per cent billion rupees worth of rehabilitation work between 1979 -1993 (Sharma, 1988; Annex 2). In

particular, hill roads are greatly affected by landslides. For example:

- ?? 400 to 700 cubic meters of landslides per km per year occur on hill roads
- ?? 10 to 25 per cent of hill roads following river valleys are completely washed out every four to five years; and
- ?? 3 to 9 thousand cubic meters of landslides per kilometre occur every year during the hill road construction period.

Man-induced and natural factors have greatly affected the land systems. Cultivation of marginal lands by seasonal crops may have also aggravated landslide occurrences. In 1996, Nepal experienced a devastating flood. Losses due to natural calamity are depicted in Table 2.4.2.

Figure 3. **Loss of humans and livestock due to Natural Hazards**

Table 2.4.2 **Losses due to Disaster in Nepal in 1996**

Area	Human Loss	Animal Loss	Affected Family	Financial Loss (in Mill. Rs.)	Affected Land (in ha)
Nepal	940	2,856	56,786	12,2482.2	6,810
EDR	219	934	35,919	11,594.2	3,916
CDR	212	682	7,418	95.4	2,144
WDR	70	729	6,400	392.2	310
MWDR	282	231	4,806	133.3	151
FWDR	157	280	2,243	33.1	289
Mountain Zone	282	961	3,990	72.6	795
Hill Zone	432	1,131	9,775	681.2	3,410
Terai Zone	226	764	43,021	11,494.4	2,605

Source: DPTC, 1997

Note : EDR = Eastern Development Region, CDR = Central Development Region, WDR = Western Development Region, MWDR = Mid Western Development Region, FWDR = Far Western Development Region

Changes in land uses and erosion problems have contributed towards expanding cultivation to steeper slopes, increasing settlements on floodplains, and continuing deforestation in upper slopes. These have all contributed to further soil loss and land degradation. The cumulative effects are decline in farm production, high sediment load in valleys and plain areas, and destruction of the infrastructures. Therefore, the need is to regulate land use changes through land zoning, and forest development.

The inherently unstable nature of mountain areas is one of the major causes of land degradation, spreading the process of desertification and land use changes. Man-induced and frequent occurrences of natural hazards such as landslides, debris flow, slope failures and increasing sediment loads have also caused the rural people to change the land system from perennial crops to seasonal crops. These events may continue to occur due to geological fragility and tendency of cultivating steep slopes, overgrazing, and inadequate soil conservation measures.

2.5 Forests and Biodiversity

2.5.1 Forests

Variation in Nepal's altitude, climate and topography presents diversity in forest types and their composition. About 50 per cent of Nepal's surface area is under some form of vegetation cover, i.e., forest and shrub land 39 per cent, and grasslands 12 per cent. About 4.2 million ha (29 per cent) is occupied by forests and 1.6 million ha (10.6 per cent) by shrub lands

(MFSC, 1999). Far Western Development Region is the most forested region with about 35 per cent of the total forest area (Table 2.5.1). Shrub land cover is evenly distributed in all the regions ranging from 8.5 per cent in the CDR to 13.5 per cent in the MWDR.

Table 2.5.1 **Forests and Shrub Area by Development Region**

('000 ha)

Region	Total land area	Forest	Shrub	Forest and Shrub Total
EDR	2845.6	736.1	362.6	1098.7
CDR	2741.0	918.6	233.8	1152.4
WDR	2939.8	734.3	256.9	991.2
MWDR	4237.8	1192.4	442.0	1634.4
FWDR	1953.9	687.4	263.9	951.3
Total	14718.1	4268.8	1559.2	5828.0

Source : MFSC, 1999

Note : EDR = Eastern Development Region, CDR = Central Development Region, WDR = Western Development Region, MWDR = Mid-Western Development Region, FWDR = Far Western Development Region

Of the 193 biogeographic provinces recognised worldwide in Udvardy's classification, only three provinces are known to exist in Nepal. They are:

- Himalayan highlands within the Palaearctic realm,
- Indo-Ganges monsoon forests within the Indo-Malayan realm; and
- Bengalian rainforest representing the later realm.

A total of 118 forest ecosystems, with 75 vegetation types and 35 forest types have been identified in different physiographic zones in these realms. Out of these, 38 types of ecosystems are represented in the protected areas (national parks, wildlife reserves and conservation areas).

Stainton (1972) broadly divided Nepal's forests into the following categories: tropical and subtropical, temperate and alpine broad-leaved, temperate and alpine conifers, and minor temperate and alpine associations. Tropical forests are predominated by *sal* (*Shorea robusta*), while *khair* (Acacia catachu) and *sissoo* (*Dalbergia sissoo*) dominate riverine forests. Mixed forests prevail in different parts of the country with deciduous and evergreen associate species. In other forest types, species compositions differ in eastern and western parts of the country. Species regeneration is comparatively good in the lowlands, and it is limited in the high mountain regions due to climatic and altitudinal factors.

The Master Plan for the Forestry Sector (MPFS) estimated a growing stock of about 522 million m^3 over-bark up to 10 cm. top diameter or on an average of 96 m^3/ha. The total biomass was estimated at 628 million tons in 1986 at the national level, corresponding to 383 million tons (61 per cent) of stem, 205 million tons (33 per cent) of branches, and 40 million tons (6 per cent) of leaves with higher percentage (37 per cent) in the Mid-Western Development Region (HMG/ADB/FINNIDA, 1988).

Forests are the main sources of firewood (energy) to about 70 per cent of the total population. Per capita fuelwood consumption in the mountains is estimated at 640 kg, while for the Terai it is 479 kg/person/yr. The household and industrial biomass fuel consumption was estimated at 14 million tons/yr. in 1995/96 as against 11.3 million tons/yr. in 1985/86. This is projected at 15.4 million tons/yr. for the year 2000/01. Based on this assumption, with the exception the Far Western Development Region and the High Himalayas, there will be a fuel deficit in the country. The annual fuel deficit at the national level is estimated to be 3 million tons in 2000/01. With regard to timber, the per capita consumption was estimated at 0.07 m^3/yr. in 1985/86. It is projected that this will increase to 0.11 m^3/yr. by the year 2001, and the total projected timber consumption for Nepal will be 2.5 million m^3 for 2000 respectively. Based on this assumption, the projected timber deficit will be 1.1 million m^3 in 2000/01 with the Central Development Region suffering the most. About 42 per cent of the total digestible nutrients (TDN) as fodder is met from forests. Based on projected fodder supply and livestock TDN requirements, fodder surplus will continue till 2000/01. However, about 0.2 million tons of fodder will be deficit by the year 2010 at the national level. But the fodder surplus is projected to continue for Eastern and Western Development Regions in 2010/11 (HMG/ADB/FINNIDA, 1988).

Loss of forest area started along with the malaria eradication and planned resettlement programmes in the late 1950s, particularly in the Terai and Inner Terai areas. Forest depletion has become most pronounced in the course of meeting the increasing demand for fuelwood, timber and other forest products. Depletion of forest area is further aggravated by overgrazing, fire, conversion to cropland, and use for settlements and infrastructure development such as roads, canals and transmission lines. The Terai and the Middle Mountain region have been most severely affected by the change in forest cover.

Use of forests and their products for different purposes has significantly changed forest cover during the last four decades. Of the total 6.4 million ha of forests estimated in 1964, only 5.5 million ha of forest area was in

natural stock. It has been estimated that a total of 0.1 million ha of forests in the Siwaliks and Terai were cleared under the government settlement programme from 1950s to 1985. An equal area was estimated to be lost during the same period due to illegal re-settlements. Overall, Nepal's forest area declined at an annual rate of 0.4 per cent during this period (HMG/ADB/FINNIDA, 1988).

Considering the forest estimates made during the LRMP (1978-"79), Master Plan (1985-'86) and the 1994 inventory, the annual reduction rate of forest cover for the whole country is 1.7 per cent in between 1978/79 to 1994 and decrease in forest and shrub together is 0.5 per cent annually (MFSC, 1999). However, the situation is different in the Hilly area where the forest and shrub cover has declined from 43.1 per cent in 1952 to 37.7 per cent in 1994. It has been estimated that the annual change in forest cover is 2.3 per cent from 1978/79 to 1994 in the Hills (MFSC, 1999). The per capita forest has also declined from 0.63 ha in 1965 to 0.442 in 1979 and further declined to 0.198 ha in 1998.

A study conducted by ICIMOD in 1996 concluded that forest conditions are comparatively better in terms of forest area. This information has been derived from a macro-scale land-cover assessment using remote sensing and geographic information system.

Forest depletion and/or deforestation is more pronounced in localised areas. The Terai areas suffer from firewood scarcity, and firewood consumption is replaced by cattle dung, indicating possible decline in soil fertility. Tree felling has been banned since the early 1980s, however, the forest stock in the Terai has not improved in terms of production. Firewood and fodder demands are met from forests in the uplands and forest depletion has thus continued. Removal of ground cover and/or the felling of trees for infrastructure development, as part of site clearance, is inevitable in the mountains. All these causes have accelerated soil loss and 1.63 mm of soil removal is estimated from the entire surface area. It has also adverse impact on wildlife habitat. Mature forests have also been converted to open grazing lands. Change in quality and quantity has multi-fold adverse impacts on the environment. In particular, the soil erosion related downstream effects are significant in terms of the production of farmland and water bodies.

Continued extraction of non-timber forest products (NTFPs), particularly medicinal plants has reduced its stock. Out of over 100 plant species in trade, five species are traded from all five physiographic zones. They are *bojho* (*Acorus calamus*), *kutki* (*Picrorhiza kurroa*), *padamchal* (*Rheum*

emodi), *chiraito* (*Swertia chirayita*), and *sugandawal* (*Valeriana wallichii*). There is an apparent increase in the trade of NTFPs corresponding with the increase in revenue from US$ 0.6 million in 1989/90 to US$ 8 million in 1995/96. These all have cumulative impacts on forest ecosystem. The annual revenue from forest is presented in Figure 4, which indicates the major contribution to be from the sales of lumber.

Figure 4. **Annual Revenue from Forests**
Source: Ministry of Forest and Soil Conservation

2.5.2 Community Forests

The Community Forestry Programme, executed by the Department of Forests of the Ministry of Forests and Soil Conservation, aims to protect, manage and use the forest by local forest users' groups (FUGs). Community forestry is a major component of the Master Plan for the Forestry Sector. Under this programme all accessible hill forests will be handed over to local communities. People within local communities that use the forest are legally recognised and authorised as the primary agents of forest management. The coverage of the community forestry programme has been extended in almost all parts of the country with the assistance of bilateral and multi-lateral donors.

It is estimated that there is a potential of 1,876,300 ha forested and of 1,585,800 ha non-forested land which can be developed as community forests. Similarly, 2,313,100 ha of Nepal's current national forest can also be considered potential community forest. As of March 2000, HMG has handed over a total of about 0.650 million ha of State-managed forest to over 9,000 community forestry user groups for the development, conservation, management and sustainable use of the forests. Through this process, about 1 million people are directly benefited from being a member of the user groups.

2.5.3 Biological Diversity

Nepal contains biological species of both Indo-Malayan and Palaeoarctic realms, including endemic Himalayan flora and fauna. Different types of forest ecosystems, including a large number of deep valleys and considerable vertical extensions have contributed to the formation of many isolated localities. This may have contributed to the varied species over the years. Phytogeographically, Nepal is also known to contain plant and animal species as found in various floristic sub-regions, including, Sino-Japanese, Irano-Turanian, Central Asiatic and Indo-Malayan floristic regions. Central Nepal is rich in diverse species and comprises both eastern and western species.

Traditional belief and use of certain parts of species for various purposes has been deeply rooted in Nepalese culture. For example, *peepal* tree (*Ficus religiosa*), *Bar* tree (*Ficus bengalensis*), *parijat* (*Nyctanthes arbortristis*), and *tulasi* (*Ocimum sanctum*) are considered sacred plants. Biological species are also major food stuffs and a source of protein. An estimation points that over 190 species of wild plants are commonly used by local people as food and fruits (MFSC, 1997). Domesticated species have further importance to Nepalese society as a majority of people depend on agriculture and livestock raising.

Nepal falls in the 25th and 11th position in terms of species richness at the global and continental level respectively. Though it constitutes only about 0.03 per cent of the total land mass of the world and 0.3 per cent of Asia, yet it harbours about 2 per cent of flowering plants, 3 per cent of pteridophytes, and 6 per cent of bryophytes of the world's flora (Tables 2.5.2).

Table 2.5.2 **Nepal's Share in Plant Species**

(In number)

Groups	Families	Nepal			World	*Nepal's share (%)*
		Genera	Species	Endemic sp.	*Species*	
Algae	50	150	687	13	> 40,000	1.72
Fungi	80	552	1,822	150	> 70,000	2.38
Lichen	30	79	471	48	> 17,000	2.77
Bryophytes	78	180	853	37	> 14,000	6.09
Pteridophytes	31	103	383		> 12,000	3.19
Flowering plants*	213	1,496	5,833	246	> 250,000	2.07

Note: * Angiosperm and gymnosperms
Source : DPR, 1999

Nepal is home to about 246 species of flowering plants and 248 species of non-flowering plants. More endemic species may be recorded after completing the country-wide plant exploration activity. Distribution of these endemic species is limited to the Himalayas, out of which Annapurna Conservation Area (55 species) is considered rich in endemic plant species followed by Dhorpatan Hunting Reserve (36 species) and Shey Phoksundo NP (30 species) (Shrestha and Joshi, 1996).

Over 1,000 species of angiosperms are originally described from Nepalese flora (Shrestha and Joshi, 1996). They also recorded a total of 93 plant species with "nepalensis" epithet and of them, 32 species are endemic to Nepal. Few plants have also been described with the epithet of Nepalese scientists. Some plant species are considered threatened due to increasing pressure on their usage. Shrestha and Joshi (1996) documented 60 non-endemic plant species and 47 endemic plant species under the threatened category. Out of the plant species endemic to Nepal, 8 species are extinct, 1 endangered, and 7 vulnerable, while 31 fall under the IUCN rare species category. Of the non-endemic plants, 22 species are considered rare, 12 species are listed under endangered category and 11 species in the vulnerable category. Annex 3 depicts a general list of flora and fauna mentioned in the CITES Appendices. In view of over-exploitation and the urgent need for their conservation, HMG has given legal protection status to 13 plant species under the *Forest Act, 1992* (Annex 4).

Similarly, Nepal is also comparatively rich in faunal species. Over 4.3 and 8.5 per cent of the total world's mammals and birds are found in Nepal (Table 2.5.3). Two species of birds and a mammal is endemic to Nepal.

Table 2.5.3 **Nepal's Share in Animal Diversity**

(in number)

Groups	**Animal Species** **World**	**Nepal**	***Nepal's share (%)***	**Endemic species**
Arthropods/insects	>1,000,000	5,052	0.44	4
Butterfly		645		29
Moth		>6,000		
Other than insects	>190,000	144*		108
Fresh water fishes	>85,000	185	0.21	8
Herpetofauna				
Amphibians	>4,000	43	1.07	9
Reptiles	>6,500	100	1.53	2
Birds	>9,881	847	8.57	2
Mammals	>4,327	185	4.27	1

Source : MPFS, 1997
Note : * Spiders only

Due to its diverse ecosystem Nepal is also a meeting point of several faunal species. A total of 645 species of butterflies belonging to 11 families are reported from Nepal in different habitats (BPP, 1995). Of these 29 species are considered endemic, 142 species threatened and 12 species endangered. With regards to insects, about 5,052 species belonging to 22 orders with five endemic species have thus far been reported. Similarly, 185 species of fishes have been recorded (Shrestha, 1995). Out of which 8 species are considered endemic, 9 vulnerable and 24 rare. About 43 species of amphibians with 9 endemic species, and 100 species of reptiles with 2 endemic species have also been reported in Nepal. Similarly, about 144 species of spiders are reported in the areas ranging from 1,000 m to 6,500 m altitude (Thapa, 1997).

Nepal is also exceptionally rich in bird species. A total of 844 species of birds are recorded, of which 11 species are considered extinct, 2 species are endemic, 22 species are listed under the IUCN threatened species category, and 40 species in the CITES appendices. Current information indicates the presence of a total of 185 species of mammals belonging to 39 families and 12 orders. The two orders - Carnivora and Rodentia are the largest orders with 43 species each, while Primates are represented by only three species (BPP, 1995). Of these, one rodent species is endemic to Nepal while three species of mammals are considered extinct. Due to the increasing pressure on wildlife, HMG has given legal protection status to 26 species of mammals, 9 species of birds and 3 species reptiles (Annex 5). With regard to the threatened animal species, 28 species of mammals, 22 species of birds, 9 species of reptiles and 2 species of invertebrates are considered threatened (Uprety, 1998).

Similarly diversity exists in domestic plants and animals. Over 400 species of agro-horticultural crops and about 200 species of vegetables have been reported in Nepal (NAA, 1995). Of these, around 50 species have been domesticated for commercial and household consumption. Seasonal fruits harvested from forests belong to about 37 genera and 45 species. In case of potatoes, about 11 local species are known. Similarly, there are more than 100 varieties of 15 major fruits, 200 varieties of 50 major vegetables and about 10 varieties of potatoes under commercial cultivation. Some of the wild genotypes have also been identified and domesticated for economic value by the local people through their own experience and wisdom. Nepal Agriculture Research Council (NARC) has stored the germplasm of various crops - cereals, grain legumes, oil seeds, vegetables, and spice species and which totals to about 8,400 accession. For rice crops alone, there are about 680 accessions and 713 for finger millet.

Plant exploration has increased the number of species each time. At present, more than 150,000 plant specimens have been collected and scientifically stored at the National Herbarium, Godavari (DPR, 1999). There is an increasing trend in the population of some wild animals. For example, the rhino count revealed a significant increase in its population, from 60 to 80 in the late 1960s to about 450 in 1994. Similarly, continued protection measures have increased the number of other endangered wild species such as tiger and musk deer. They are conserved in the protected areas, forests, botanical gardens, conservatories and zoo.

In general, species outside the protected areas are under great pressure due to habitat loss and/or degradation, over-extraction and illegal collection of forest products, and poaching and hunting of wild animals. Wild animals are illegally hunted or poached due to the economic value of their products. For example, the sloth bear is hunted for its gall bladder, rhino for its horn, musk deer for its musk, and tiger and leopard for their skin and bones. However, the loss of biodiversity has not been clearly recorded. But it can be safely summarised that if the present consumption pattern of forest products, introduction of breed varieties of cattle, and collection of forest and wildlife products continues, without knowledge of the carrying capacity, it will pose adverse impacts on biological species and cause genetic erosion.

Forest management in Nepal is evolving from tree protection to ecosystem management. Forests are under pressure for meeting the demand of forest products such as firewood, fodder, timber, and other non-timber forest products, including medicinal plants. Based on the current trend of forest

production in natural stock, the firewood and timber deficit will continue in the future. Forests are also experiencing pressure due to shifting cultivation and development activities. These have contributed to loss and/or degradation of wildlife habitat.

Nepal is rich in wild and domesticated plants, and animal species in terms of per unit area. The percentage share of wild plants and animals with global biodiversity calls for their conservation and sustainable use. The present policy of forest management through forestry user groups, conservation area development and management, and buffer zone management approaches will help to strengthen natural resources conservation with people's participation.

2.6 Energy

Energy demand is met from a combination of traditional and commercial sources such as fuelwood, agricultural residues, animal waste, solar power and hydropower. Hydro-resources represent a large fraction of the total theoretical energy potential (83,000MW) and economically feasible potential of 42,000 MW. However, thus far only about 253 MW of hydropower has been harnessed which accounts to about 0.3 per cent of the total power potential. Energy consumption has been increasing over the years along with population growth. The consumption rate has increased by about 50 per cent, from 4.5 million Tons of Oil Equivalent (TOE) in 19980/81 to 7.1 million TOE in 1998/99. The traditional and commercial sources of energy accounted for 88.9 per cent and 11.1 per cent in 1997/98 respectively, and there is an increasing trend of utilising commercial energy. Of the total commercial energy, the share of petroleum product, coal and electricity were 7.8, 2.3 and 1.0 per cent respectively. Traditionally fuelwood has been the major source of energy, and about 79 per cent of the total population met their energy demand from forest products. The share of wood, agriculture and livestock residues is estimated at 79.4, 3.6 and 5.9 per cent respectively (MOF, 1999). Agricultural residues and animal waste (dung) are now evolving as major sources of energy in the countryside, which could be used for farm production also.

Nepal also depends on imported fossil fuel. While there is continued exploration for identification of petroleum reserves, a few potential sites of natural gas have already been identified. For example, Kathmandu Valley is known to have natural gas reserves of about 300 million m^3. For non-conventional energy resources the solar energy potential is estimated at 26.6 million MW (WECS, 1996). Thus far four solar power stations are in

operation in a limited scale. Of these four stations, the following are being operated by the government. They are at Gamgadhi in Mugu, Simikot in Humla, Kodari in Tatopani, Sindhupalchok. While the one at Risti - Pulemarang in Tanahu is operated by a NGO. The potential of wind energy is yet to be determined. However, Kagbeni in Mustang District is known to have a potential of generating about 200 MW of electric power, with an annual energy production of 500 GWh. Potential geothermal energy is yet to be estimated, though about 100 geothermal springs of tectonic origin with surface temperature ranging form 25-45^0 C are localised in 10 major areas (Rana, 1986). Biogas has also become an important alternative energy source with an annual potential production of about 1,200 million m^3, which is equivalent to 29 million Giga Jules (GJ).

Biomass is primarily used as fuel for cooking and heating as well as fodder for livestock. The total fuelwood supply is estimated to be 5.4 million metric tons, of which government forests alone contribute to about 70 per cent. On an average, the annual energy consumption pattern is approximately 92 per cent of fuelwood, including biomass, 7 per cent fossil fuel and 1 per cent electricity out of 0.285 million Gj (WECS, 1996; Table 2.6.1). There are significant differences in the trend of utilisation of different energy source. Commercial energy consumption has grown rapidly in comparison to traditional fuel. The per centage share of fuelwood is estimated to have reduced from 73 per cent in 1984/85 to 69 per cent in 1994/95, while the use of electricity increased from 0.53 GWh to 0.99 GWh per cent during the same period. Per capita generation of 54 kWh and the per capita consumption of 61 kWh in the fiscal year 1997/98 are nominal figures in the present age of energy utilisation. Electricity generation over the last few years indicates an average growth rate of 4.48 per cent, while consumption is growing at an average of 7.62 per cent. Thus far nearly 0.55 million households have received electricity.

The sectoral energy consumption trend and percentage share of energy consumption for the period of 1984/85 to 1994/95 is presented in Annex 6. The share of domestic sector in the total energy consumption has gradually declined from 93 per cent in 1984/85 to 91 per cent 1994/94, whereas the energy consumption in the industrial sector has nearly doubled during the same period.

Table 2.6.1 **Yearly Energy Consumption and Percentage Share by Fuel Type**

Year	Energy Consumption						Total (GJ)
	Fuelwood (MT)	Agri Res (MT)	Animal Waste (MT)	Coal (MT)	Petroleum (KL)	Elect (GWh)	
1984/85	9,465 (73.22)	2,105 (12.21)	1,850 (9.30)	145 (1.68)	147 (3.10)	287 (0.53)	2,16,525
1985/86	9,669 (73.36)	2,137 (12.32)	1,878 (9.39)	17 (0.19)	139 (3.21)	320 (0.39)	2,17,806
1986/87	9,769 (72.77)	2,281 (12.74)	1,898 (9.19)	91 (1.02)	177 (3.67)	382 (0.53)	2,24,866
1987/88	9,953 (72.61)	2,414 (13.20)	1,918 (9.10)	84 (0.92)	171 (3.46)	449 (0.51)	2,29,602
1988/89	10,142 (72.18)	2,554 (13.63)	1,938 (8.97)	76 (0.81)	185 (3.69)	479 (0.52)	2,35,358
1989/90	10,256 (71.69)	2,707 (14.19)	1,959 (8.90)	12 (0.13)	223 (4.30)	525 (0.79)	2,39,633
1990/91	10,503 (70.89)	2,864 (14.49)	1,979 (8.68)	81 (0.82)	230 (4.26)	589 (0.85)	2,48,190
1991/92	10,780 (69.07)	3,031 (14.56)	2,000 (8.33)	92 (0.88)	293 (6.25)	652 (0.90)	2,61,416
1992/93	10,979 (68.80)	3,207 (15.07)	2,021 (8.24)	110 (1.04)	359 (5.96)	694 (0.89)	2,70,915
1993/94	11,460 (69.11)	3,288 (14.87)	2,094 (8.21)	104 (0.94)	353 (5.96)	706 (0.91)	2,77,768
1994/95	11,715 (68.71)	3,418 (15.03)	2,124 (8.10)	113 (0.99)	382 (6.19)	787 (0.99)	2,85,600

Source : WECS, 1996.
Note : Figures in parenthesis indicate percentage.

In the commercial sector, energy is being consumed at an increasing rate of 15 per cent per annum and in the transport sector it has increased by 10 per cent annually within the same period. Similarly, energy consumption by the agricultural sector has increased from 0.14 to 0.71 per cent in this decade (WECS, 1996).

Biogas is also used as a dependable alternative source of energy in rural areas. Biogas development is being promoted by both the government and NGO sector. In 1998/99, over 9,800 biogas plants were installed, of which over 7,000 plants were established under the loan investment from Agriculture Development Bank (MOF, 1999). Biogas generation and its use is gaining importance in the Terai and the valleys where temperature variation favours its development.

Figure 5. **Structure of Energy Consumption in Nepal**
Source : MOF, 1999

The present scenario of energy supply and demand in the country depicts an unbalanced picture. Heavy dependence on firewood coupled with the high population growth rate is exerting a continuous pressure on forests. The Water and Energy Commission Secretariat estimated the deficit in fuelwood supply to be 6.6 million tons during 1996. According to the Master Plan for the Forestry Sector the total biomass fuel consumed in 1985/86 was about 11.3 million tons, which increased to 14.1 million tons in 1995/96. With the exception of the Far West Development Region, fuelwood deficit prevails all over the country (HMG/ADB/FINNIDA, 1988). The deficit is likely to be met either by reducing consumption, by over-cutting the accessible forests, or increasing the use of agricultural residue and dung. Over-cutting of trees will further contribute to the expansion of shrub areas. On the other hand, diversion of agricultural residues and animal dung from field manure to household cooking fuel will progressively deplete nutrients in farmlands. Moreover, burning such fuel adds to indoor air pollution.

Primary sources of energy in Nepal are fuelwood and biomass. Fossil fuel utilising sectors such as transport, industry, agriculture and other commercial establishments have a share of 7 per cent only. Despite a huge hydropower potentiality in the country, its share is less than 1 per

cent. Development of hydropower by the government and private agencies is being accelerated to bridge the widening gap between electricity demand and supply. The private sector is implementing the Khimti and the Upper Bhotekoshi hydropower projects with an installed capacity of 60 MW and 36 MW respectively (Box 2.3). HMG is also encouraging implementation of micro hydropower projects in the hill districts through local private investors. Both government and private institutions are involved in promoting this technology. Yet, despite various efforts, rural people will continue to depend on traditional sources of energy and its impact on forest, land system and human health will likely continue, at least for the near few years. However, the present policy of involving the private sector in hydro-power development will help generate surplus power and open new avenues for sectoral development. It will also reduce the heavy dependence of the people on the forest.

Box 2.3

Kali Gandaki	Installed Capacity	144 MW
	Annual Energy Generation	842 GWh
Puwa Khola	Installed Capacity	6.2 MW
	Annual Energy Generation	48 GWh
Modi Khola	Installed Capacity	14 MW
	Annual Energy Generation	91 GWh
Chilime	Installed Capacity	20 MW
	Annual Energy Generation	137 GWh

2.7 Solid Wastes

Prior to 1950, solid wastes were locally managed in the urban areas, including the Kathmandu Valley. Almost all the wastes were used as organic manure. In due course of time, significant change in the both volume and character of the wastes generated led to haphazard disposal and dumping in nearby open spaces. This practice is on the increase in the municipal areas. At present, solid waste management in both industrial and domestic sectors has been a cause for great concern in urban areas of Nepal. In Kathmandu Valley, the Solid Waste Management and Resource Mobilisation Centre (SWMRMC) - established in mid-1980s - with assistance from GTZ initiated collection, segregation at transfer stations, transportation and final disposal in the sanitary landfill site at Gokarna. Even now, municipal solid wastes of the Valley are collected, transported and disposed off through institutional efforts of both the SWMRMC and the Municipalities. However, solid waste management still poses a problem in Kathmandu Valley.

Solid waste composition and generation is an outcome of economic activities of the households. Literature based on estimation and sample surveys in Kathmandu indicate the waste generation rate to vary from 0.25 to 0.45 kg/person/day. Three-fourth of the wastes is organic or biodegradable (Table 2.7.1). An estimate also indicates over 550 cubic meters of waste generation in the Kathmandu Valley. Another study noted that more than 90 per cent of the Valley inhabitants are willing to pay service charges for waste removal provided the management system is effective (Thapa and Devkota, 1999) (Annex 7).

A sample survey of 31 private hospitals in Kathmandu Valley revealed hospitals to generate 191 kg of wastes per day (IIDS,1997). Generation of wastes in the health institutions is approximately 5.71 kg per patient per day, out of which nearly 30 per cent is hazardous by nature. Due to lack of separate provisions for managing such wastes, they are mixed with municipal refuse.

In Nepal, organic wastes were traditionally reused for agriculture production by composting the household wastes. Segregation of municipal wastes and composting was later introduced in an urban waste management exercise. In 1986, the SWMRMC established a sizeable plant with a capacity of producing 30 tons of compost a day in an area of 1.8 hectare. Local farmers purchased the manure produced at a subsidised rate of NRs. 250/ton. This activity was later stopped due to its proximity to a heavily populated urban area (Teku). Bhaktapur is now the only municipality which has a compost plant in operation with an installed capacity of 5 tons a day. Some community-based organisations (CBOs) have also started to operate small-scale compost plants for demonstration purposes and are presently disseminating the message that "waste has a value".

Efforts on recycling and reuse of wastes have also been initiated and are promoted by the government and non-government sectors. For example:

- Farmers are using restaurant wastes to feed their pigs and cattle;
- Butchers are producing organic manure from the slaughter wastes, including bones;
- Used paper is recycled by a number of industries; and
- Some factories have metal, glass, plastic and rubber recycling facilities.

The waste reuse practice is gaining popularity in selected urban areas in Nepal.

Table 2.7.1 **Domestic Waste Composition by Municipalities**

Municipality	Percentage of bio-degradable wastes
1. Kathmandu+	78.0
2. Pokhara *	78.5
3. Biratnagar +	77.0
4. Nepalgunj *	75.0
5. Janakpur *	87.0
6. Hetauda *	56.0
7. Birgunj *	51.0
8. Sidarthanagar	84.0

Note: + figures taken from CEDA, 1989
** figures taken from SWMRMC, 1985/86.*
Source: CBS, 1994

The solid waste management problem experienced in Kathmandu Valley is also being increasingly faced by other municipalities such as Pokhara, Biratnagar, Birgunj and Nepalgunj. The problems that have surfaced are also multifaceted because of the change in volume and character of the waste generated, inadequate technology transfer and adoption, and lack of public awareness. Lack of waste management skill has further compounded the issue.

Most of the wastes generated in Nepal can be reused and/or recycled. In general, two-thirds of the waste comprises organic matter which has economic value. This has attracted the attention of some waste recycling industries, which should be promoted by encouraging resource recovery schemes and policies. A recent policy for inviting the private sector for municipal waste management could encourage their involvement in solid waste management and resource mobilisation. Introduction of a mechanism for compost making, recycling of waste into useful by-products, decentralisation of waste collection services, waste segregation and proper management, including the hazardous wastes, could contribute to changing the present situation.

2.8 Air and Water Pollution

2.8.1 Air Quality

Change in the quality of outdoor and indoor air is an emerging concern in both urban and rural areas of Nepal. Air pollution, which occurs from natural as well as anthropogenic activities, is an outcome of various

sources of pollutant, its dispersion and receptors. An example of a natural process is the seasonal dust storm in the valleys. Anthropogenic activities have been largely responsible for changes in the air quality in both urban and rural areas. Some major sources of such pollution are vehicular and industrial emissions, and combustion of biomass and fossil fuels.

In the rural areas heavy indoor air pollution is caused by the combustion of biomass in the poorly ventilated kitchen rooms. The emission of pollutants from the combustion of traditional biomass in open cooking-stoves, particularly in poorly ventilated kitchens, has its own implications on human health. Bronchitis, pneumonia and other respiratory problems are common among rural women and children. Furthermore, a statistically strong association of chronic bronchitis and decline in lung function has been reported due to burning of biomass fuel (Pandey *et al*, 1985). People of the Hills and Mountains suffer from these health problems frequently.

Meanwhile, vehicular emission is the major cause for the deteriorating air quality in the urban areas where vehicular emission is much aggravated by substandard or adulterated fuel, narrow and poorly maintained streets, poor traffic management, old vehicles and poor vehicular maintenance. More recently conditions have deteriorated due to heavy vehicular traffic in major towns such as Kathmandu, Pokhara, Biratnagar and Birgunj.

In the process of developing the country's infrastructure, primary attention has been given to the road sector. Since the formation of the first elected government in 1959, His Majesty's Government of Nepal (HMG/N) has given top priority to the expansion of roads. The total road length in the country has increased from 624 km in 1956 to 13,400 km in 1998.

However, during the monsoon season landslides and floods heavily affect the roads. Furthermore, despite the development in the road sector the increasing number of vehicles, along with the vehicular registration in Nepal, reveals the total number of vehicles to have nearly doubled within half a decade. Concentrations of these vehicles in some particular area have further worsened the impact on roads. Although the exact number of vehicles plying in different parts of the country is unavailable due to lack of statistics about the numbers of vehicles which have been junked, the capital city of Kathmandu alone comprises nearly 50 per cent of the total vehicles registered in Nepal. Various efforts to control vehicular pollution have been implemented. A vehicular colour rating system with respect to the exhaust emission standards has been introduced by HMG/N In 1995. This system provides green stickers to vehicles meeting the emission standard and red stickers to vehicles failing the test. As of Mid-April 2000

nearly 0.136 million vehicles have been tested. Of them, over 30 per cent failed to comply with the standard. In 1996, HMG tested the vehicles by introducing the standard of 3 per cent CO for petrol vehicles and 65 per cent HSU for diesel vehicles. In 1998, this standard was revised to 4.5 per cent CO to petrol operated-four wheelers manufactured before 1980 and 3 per cent CO to such vehicles manufactured after 1981. In case of diesel-operated vehicles, 75 per cent HSU was introduced for all diesel vehicles manufactured before 1994 and 65 HSU for vehicles after 1995.

Among the vehicles, buses, trucks, tempos and two stroke motorcycles are probably the most significant contributors of air pollution. Based on vehicle exhaust emission test, it clear that about one-third of the vehicles tested failed to comply with the existing standards (Annex 8). Vehicles in Kathmandu Valley alone use 79 per cent of gasoline and 27 per cent of diesel oil imported in the country.

The ambient air quality in Kathmandu indicates that with the exception of total suspended particle (TSP) and particulate matter (PM_{10}), other criteria pollutants are well below the WHO guidelines (Table 2.8.1). Based on the amount of TSP within the Valley atmosphere, available data indicates winter days to be more polluted than summer days. Industries also play a major role in increasing the load of air pollutants. An industrial pollution inventory carried out by the Industrial Pollution Control Management Project (IPCMP) indicated a total of 3,156 air polluting industries emitting almost 76,400 tons of TSP matter annually (Devkota & Neupane, 1994). In general, the TSP load within the Kathmandu Valley atmosphere emitted from medium and large sized industries is estimated to be 104 tons per day. A recent IPCMP survey on stack emission from selected industries indicated that industrial resource losses through the top of the stacks were up to 10 per cent in case of liquid fuels utilising boilers (Devkota, 1997; and Table 2.8.2).

The petrol and diesel fuel generally available in the market is of sub-standard quality which contains low octane and high content of lead and carbon has also contributed to the increasing air pollution. Poor vehicle maintenance has further compounded the problem as it does not allow for full combustion of the fuel. Most of the lead in the air is in the form of fine particles of less than 2?. Bhattarai and Shrestha (1981) reported a direct correlation between the heavy vehicular traffic and lead concentration in soil (dust particles) which was higher than 300 PPM. It is thus apparent that lead concentration in the streets of Kathmandu are many folds higher than the background value found in normal soil (<0.01 PPM for garden soil). Recent studies also show that the lead content in the ambient air quality of Kathmandu city varies from 0.18?g/m^3 (Maharajgunj) to 0.53?g/m^3 (around

Royal Palace), 2.6?g/m^3 (Kalimati) and 6.08?g/m^3 (Bhotahity) (NESS, 1995).

Table 2.8.1 **Ambient Air Quality in Kathmandu Valley** (?g/m^3)

Parameters	**Monitoring Time**	**Monitoring Years and Level**			
	(hour)	1993*	1995**	1997***	1998**
Total Suspended Particulate (TSP)	24	241	NA	NA	950
	8	342			
Particulate Matter (PM_{10})	24	104	637.5	172.98 to 2336.14	NA
	8	99			
	1 minute				
Nitrogen dioxide (NO_2)	24	26	NA	NA	NA
	8	39			
Sulphur dioxide (SO_2)	24	36	NA	NA	NA
	8	48			
Carbon monoxide (CO)	Spot analysis	<10 (PPM)	N/A	N/A	NA

*Sources: *Devkota, 1993 (Continuous monitoring & average value);*
*** NESS, 1995 / 1998 (Grab sampling - personal communication);*
**** Leaders Nepal 1997 ($PM_{7.7}$) (Grab sampling for ten minutes)*

Note : NA = Not available

Table 2.8.2 **Stack Emission of Industries**

Boiler Type	**Boiler**	**Stack loss (%)**		**Emission of Pollutants (g/m^3)**					
		Min	**Max**	**CO**		**NO_x**		**SO_2**	
				Min	Max	Min	Max	Max	Min
Furnace Oil	2	8.89	9.18	122	241	239	250	872	1588
Diesel Oil	10	3.86	9.75	0	308	94	203	105	419
Kerosene Oil	6	3.0	6.2	0	34	96	181	10	26
Rice Husk	7	67	90^X	41	7803	66	289	0	86^{XX}

Note : ^{X} Gross Efficiency
^{XX} Fuel mixed with charcoal

Source : Devkota, 1997

When solid particles containing lead is inhaled, they are trapped in the lungs resulting in the accumulation of lead in the blood system. As lead is neurotoxic, long-term exposure to a high level of lead in blood can lead to

adverse effect on blood formation, vitamin metabolism and neurological systems. About 152 tempo drivers, both smokers and non-smokers, were tested over a span of three weeks to identify the impact of air pollution. The study revealed significant differences between the exposed and the control group smokers on cough, breathlessness and nasal symptoms (Shrestha, 1993).

Sporadic studies have also been conducted to assess the level and impact of indoor pollution on human health in Nepal. One of the studies indicated the prevalence of chronic bronchitis to be a maximum of 29.0 per cent in Jumla (Mid-Western Development Region), and 8 per cent in the mid-hill region of urban Kathmandu (Pandey et al., 1985). The study further also revealed that women spend about 20 per cent of their work time in cooking related activities, and are thereby exposed to smoke with all the consequences of acute respiratory tract infection, chronic bronchitis and *cor pulmonale*. Indoor pollution in industries also poses a considerable threat to the health of workers.

2.8.2 Water Pollution

Water pollution through natural processes is insignificant in Nepal. Domestic sewage and industrial effluents are the major contributors of water pollution. Haphazard urbanisation and inadequate sewerage facilities have accelerated the discharge of domestic liquid wastes without any treatment. Almost all the urban areas have no wastewater treatment facilities. The cumulative effects of wastewater discharge have a striking negative impact, particularly, in the rivers flowing through the Kathmandu Valley. The holy river Bagmati is biologically dead due to discharge of such domestic and industrial wasters, particularly in the stretch flowing through urban areas.

Biological contamination is generally noticed in the supplied drinking water as well. Frequent incidence of water-borne diseases indicates the deterioration of the drinking water quality in both urban and rural areas.

Although the contribution of the manufacturing industries to the gross domestic product (GDP) is estimated to be around 10 per cent, most of them discharge the effluents and solid wastes without any treatment. According to the latest Census (1996//97) of industries, the number of establishments and persons engaged in all VDCs were about 1,594 and 92,344 as against 1,963 and 1,04,364 in all Municipalities. Compared to the previous 1991/92 Census, carpet and rugs, garments, bricks, distilleries and printing establishments have decreased in numbers during 1996/97 Census.

With a concentration of 56.76 per cent of total manufacturing establishments, the Central Development Region (CDR) is found to be the most busy region in manufacturing activities. The region shares 70.54 per cent of the total employees, and 73.04 per cent of total wages and salaries. It has also shared 76.04 per cent of the total value added with 66.84 per cent of input and 70.5 per cent of the total output.

In contrast to the CDR, the Far-Western Development Region (FWDR) shares only 3.74 per cent of the total number of manufacturing establishments.

Localised industrial pollution is also on the rise. Wastewater is directly discharged on to the terrestrial and aquatic systems without any treatment. The wastewater generally contains a high load of oxygen demanding wastes, disease causing agents, synthetic organic compounds, plant nutrients, inorganic chemical and minerals, and sediments (Devkota and Neupane, 1994). The general scenario of industrial pollution in Nepal based on the Industrial Census of 1991/92 is presented in Annex 9. Total industrial wastes have been estimated at 0.076 million tons of TSP, 8.557 million cubic meter of wastewater, 5.7 thousand tons of BOD, 9.6 thousand tons of TSS and 22 thousand tons of solid wastes. Industrial TSP release in the Kathmandu Valley exceeds the total load discharged in all other development regions. A recent sample survey of 36 industries throughout the Kingdom revealed that the population equivalent (PE) of industrial effluent ranges from 416 to 9,540 (Devkota, 1997; Table 2.8.3). It is generally accepted that local human PE is about 50 gram per day.

The total solid waste generated by different industries is estimated to be 22,000 tons. In general, the major solid waste generating industries are leather, canning, sugar and distillery. Most of the wastes generated are of biodegradable nature with the exception of plastic, rubber and bottles, which can be recycled or reused.

Air pollution has been a major concern in urban areas such as Kathmandu, Biratnagar and Birgunj. Both vehicular and industrial air pollution is on the increase. Absence of long-term data has limited defining trend of definite trend on air pollution, even in Kathmandu Valley. Limited data and experience prevents implementation of pollution control measures in the valley. If this trend continues, it is likely that other urban areas of Nepal will have to face similar consequences.

Table 2.8.3 **Characteristics of Industrial Wastewater**

		Maximum observed values									
Sector/source	Sample size	pH	Conductivity (ms/cm)	Salinity (. /.)	Temp (^{0}C)	TDS (mg/l)	BOD (mg/l)	COD (mg/l)	TSS (mg/l)	O/G (mg/l)	PE
Iron and steel galvanizing											
Pickling waste	3	1.54	2.39	1.1	44.4	2850	n.a	96	30	n.a.	
Soap manufacturing											
Combine final outlet	3	14	153	220	43.8	174800	8220	33500	17400	90	822
Pulp and paper	2										1713
Black liquor		10.4	39	25.2	32.9	31350	32450	13600	15200	2200	
White liquor		9.34	1290*	1.9	35.7	9000	1824	9833	2044	50	
Vegetable oil/ghee											
Neutralization wash	4	9.08	4.1	4.1	48.8	10850	4717	5320	5350	580	2000
Textile											
Combine final outlet	4	6.36	2210*	0.1	33.4	2210	732	5750	140	9.8	4392
Brewing											
Combine final outlet	2	8.04	521*	0.1	29.4	278	514	725	90	n.a	1542
Distillery Spent wash	1	4.4	18.13	10.9	84.5	18550	13040	54000	11230	n.a	9540
Beverage/soft drink											
Combine final outlet	3	9.05	2.7	1.3	33.2	1236	196	300	66	1.4	720
Food processing											
Combine final outlet	3	4.91	863*	0.2	36.7	350	2372	3800	1200	12.4	1423
Leather tanning											
Combine final outlet	3	13.58	3	1.4	29	9900	1035	6500	8267	1230	1035
Carpet dyeing	4										1142
Light spent dye bath		4.71	2.62	1.4	84.2	1072	648	860	280	4.2	
Dark spent dye bath		4.82	5.08	2.8	82.1	3595	2208	2300	400	5.8	
Carpet washing	4										416
Sulfuric acid + bleaching		1.02	21.6	13.1	27.1	1200	184	456	672	4	
Caustic soda wash		14	10.4	6	28.6	4531	230	540	320	8.7	
Sulfuric acid wash		1.07	19.87	12	28.1	4115	210	620	294	5.5	
Detergent wash		2.53	2.85	1.4	28.1	316	207	330	132	4.3	

Source: Devkota, 1997

Note : TDS: total dissolved solid; BOD: biological oxygen demand; COD: chemical oxygen demand; .TSS: total suspended solid; O/G: oil and grease; PE: population equivalent.

** unit in ?s/cm*

Although urbanisation and industrial development is at an infancy stage, water pollution is rapidly increasing in most of the areas of the country, both in urban and rural areas. Water quality is degraded through the discharge of untreated domestic wastewater and industrial effluents. Continued efforts are required to minimise pollution load through the enforcement of pragmatic standards for specific types of industries, provision of incentives for use of cleaner technologies, and effluent treatment facilities. Industries should also be promoted to comply with the environmental regulatory measures. Industrial operators should also be encouraged to minimise the waste load through good house keeping practices, appropriate water management, stocking of required raw materials, optimum use of chemicals, and adoption of recovery and reuse process and complying with discharge standards.

2.9 Noise Level

Though noise pollution does not cause direct damage to the environment, however, like other sources of pollution, it can affect human health physically and psychologically either by causing permanent damage or by reducing efficiency in urban areas. Surface transportation is the predominant source of high noise level. Power tillers, buses, heavy trucks and three- wheelers (tempos) are found to be significant contributors to the high noise pollution in municipal areas. Old and poorly maintained automobiles further aggravate the noise pollution problem causing significant health problems. Findings indicate the highest noise level (101.9 dB) to prevail in high traffic areas such as Singha Durbar. The mean values of noise level for low traffic areas range from 67.67 dB to 75.21 dB in public places, and 74.52 dB for residential cum commercial area (Sapkota et al., 1997) (Table 2.9.1). Excessive noise levels are the result of inadequate mufflers fitted in vehicles, increasing number of old and noisy two-stroke vehicles, heavy-traffic congestion and use of pressure horn.

The level of noise produced in industries depends on the type of machines and processes adopted. Sporadic studies indicate fairly high indoor noise levels (Shrestha & Shrestha, 1985; Miyoshi, 1987). Out of the 125 industries surveyed, the noise levels were higher in textile, cement, paper, marble, iron, steel, sugar, leather and jute industries (NECG, 1991). Miyoshi (1987) reported a range of 100 dBA in some industries such as Balaju Kapada Udhyog, Balaju Autoworks, Aluminium Industry, Timila Metal Co., Hulas Steel Industry, Hetauda Cement, Khadya Udhyog and Himal Cement which exceed the international safety standard. Furthermore, high noise level has been experienced through mike related activities.

Table 2.9.1 **Noise Level in Kathmandu**

Areas	Equivalent	Noise Level Exceeded %			
	Noise level Leq	Ln_{10}	Ln_{50}	Ln_{95}	L_{max}
High Traffic	78.97	80.97	75.34	69.04	97.11
Low Traffic	75.21	78.0	71.96	64.62	94.19
Public Places	69.67	72.0	67.04	62.34	86.82
Residential and Commercial Places	74.52	77.02	70.44	63.38	92.27

Source: Sapkota et al., 1997

In sum, noise level is also on the increase in the municipal and industrial areas. Though the impact of high noise level on human health has not been correlated, yet it is likely to be a major concern in the near future. This calls for the adoption of stringent road traffic system at least during the peak hours, implementation of air and noise quality standard, and launching awareness programmes on their impacts on human health.

2.10 Agriculture

2.10.1 Crop Production

Agriculture is the predominant economic activity in Nepal. Over 80 per cent of the total population still depends on agriculture for subsistence living. Based on the available information on land use, about 21 per cent of the total land in the country is cultivated. About 1.7 million ha. of agriculture land is rainfed, which accounts for almost 65 per cent of the total cultivated land. On an average, the Terai (plains) comprises of about 43 per cent of total cultivated land, while the remaining land lies in other physiographic zones. The distribution of agricultural land is highly skewed, with 16.1 per cent of the farmers owning 62.8 per cent of land. Half of the farm holdings are below 0.5 ha., averaging a mere 0.15 ha. Small farmers clearly dominate the Nepalese agriculture.

Crops grown in Nepal are broadly divided into two groups, namely, food and cash crops. The main food crops are paddy, maize, wheat, potato, millet, barely and pulses. Among these crops, paddy occupies about 55 per cent of the total land. Approximately 80 per cent of the paddy is produced in the Terai region. Maize, millet and potato are basically hill crops. Other food crops are cereals, pseudo-cereals, tuber crops and pulses. The main cash

crops are sugarcane, jute, tobacco, tea, cotton, cardamom, fruits, etc. Most of these crops are produced in the Terai. During the last ten years, some of the hill districts in eastern Nepal such as Ilam and Sankhuwasabha have been diversifying the cropping pattern towards the production of cardamom, tea and fruits.

The cropping system, whether irrigated or rainfed, depends on land type and the physiographic region. The major cropping patterns in various types of land in different physiographic regions indicates that the dominant cropping patterns in the hills and plains are maize-based and rice-based respectively. Pulses like black-gram, soybean and pigeon pea are also grown on paddy bunds in the lowlands. A typical crop rotation in the middle hills differs from year to year. In the first year the cultivation of upland rice is followed by blackgram, while during the second year the relay crops are maize and millet. The same crop rotation pattern is repeated during the subsequent years. This kind of indigenous cropping system developed by farmers in the Middle Hills is suitable for maintaining soil fertility and providing fodder.

Contribution of the agricultural sector in the gross domestic product (GDP) was about 69 per cent in 1974/75. This declined to 52 per cent in 1987/88 and 40 per cent in 1997/98 (MOF, 1999). Most of the cereal and cash crops indicated an increasing trend during the FY 1998/99.

In FY 1999, the output of the principal cereal crops in the country was estimated to be 6.46 million ha with an increase by 2 per cent from the previous year (MOF, 1999). The trend in the production of major cereal crops with agriculture inputs is shown in the following figures. However, there is an increasing trend in the production of cash crops such as sugarcane. In spite of increased irrigation facilities, and use of other agri-inputs, the decline or increase in yield rate is determined by weather condition. Adverse weather conditions result in the decline of production of both cereals and cash crops.

The amount of food available per capita has been declining. While an increasing number of districts are experiencing food deficits, the gap between food requirements and consumption is increasing. The cultivated areas of most food grains have also been increasing.

However, different types of chemical fertilisers (organic and inorganic chemicals) are unproportionately used for cultivation. Consumption of chemical fertilisers began to increase progressively after 1980s from about 7 kg NPK/ha/yr. in FY 1979/80 to 25 kg NPK/ha/yr. in FY 1992/93.

Similarly, the use of pesticides is also on the increase. About 250 types of pesticides, 40 types of herbicides and different fungicides are used to minimise the loss of agriculture production from pests and insects. However, in spite of high doses of agri-inputs, agriculture production increase has not been significant. For example, the yield rates of paddy indicate slight increase from 1.98 mt/ha. to 2.42 mt/ha. with significant variations between 1974/75 to 1998/99. For maize, it has been on the decline from 1.81 mt/ha. to 1.71 mt/ha. during the same period. However, the yield rate of wheat has slightly increased from 1.14 mt/ha. to 1.55 mt/ha. In sum, considering the base year as 1974/75 (100) the yield rate of principal food crops has reached 111 mt/ha. in 1998/99. During this period the food crop area increased by 1 million ha, and total production by 2.5 million tons (MOF, 1999).

Figure 6. **General Trend in Production of Cereal Crops**
Source : MOF, 1999

Cash crops occupy a small percentage of the total cultivated area. Over the last few years cash crop production increased between 5.8 and 2.6 per cent during the fiscal year 1994/95 and 1995/96 respectively. In case of principal cash crops (sugarcane, oil seed, tobacco, potato and jute), the area increased by 140 thousand ha with over four-fold production (670 to 2,782 thousand mt) during the period 1974/75 and 1998/99. The yield rate for all crops is also on the increase with fluctuations in different years, indicating the fluctuations in agri-inputs and climatic conditions.

Land degradation has also negated farm production. Realising this problem, farmers are shifting from traditional organic farming to chemical farming. Efforts are therefore underway to regulate the use of pesticides through the *Pesticide Act, 1991* and *Pesticide Rules, 1993*. Similarly, Integrated Pest Management (IPM) has been introduced in order to minimise impacts on the agricultural environment. In commercial farming the national average consumption rate of pesticides was estimated to be 650 g/ha. Misuse and overuse are the two distinct routes of pesticide pollution. Pesticide residues have been detected in rice, wheat, and pulse grains in godowns and even in milk. In 1997, the Pesticides Registration Office at Department of Agriculture estimated that about 60 metric tons of different pesticides have been imported into Nepal. More than 50 metric tons of obsolete pesticides of hazardous nature, albeit persistent, are yet to be disposed off.

2.10.2 Mineral Fertilisers

Mineral fertilisers were first introduced into Nepal in 1952. In 1954 fertiliser consumption was 10 tons, and by 1965 it had increased to about 1,500 tons. It was only in 1965/66, with the establishment of Agriculture Inputs Corporation (AIC), then known as Agriculture Inputs Supply Corporation, that organised supply of fertilisers actually began in Nepal. AIC began its fertiliser trade operation with 3,196 tons of fertilisers received as aid from India (2,169 tons) and the former Soviet Union (1,000 units). Most of this (2,500 tons) was ammonium sulphate (21% N). In the FY 1965/66, the amount of fertilisers sold was 2,069 tons. Sale of fertilisers at that time was mostly confined to the Central Development Region, mostly around Kathmandu Valley and the surrounding hills, and the Birganj area of Bara, and Parsa districts in the Terai region. The consumption of mineral fertilisers increased from a mere 2,069 tons (451 tons N, P_2O_5 and K_2O) in 1965/66 to 185,797 tons (90,277 tons N, P_2O_5 and K_2O) in 1994/95 (Figure 8). However, fertiliser usage is still very low in Nepal. As a result, the maximum national average consumption of fertiliser nutrient (in terms of N, P_2O_5 and K_2O) in Nepal was about 35 kg/ha/annum in 1994/95, which is

the lowest after Bhutan in the SAARC (South Asian Association for Regional Co-operation) region. Fertiliser consumption has actually declined in recent years against the projected plan of increase. The Eighth Plan (1992-97) sought to raise the overall average fertiliser nutrients use from 31 to 83 kg/ha/annum. Given this scenario, the APP fertiliser nutrient use target of 150 kg/ha/annum by the year 2015 seems doubtful, though not impossible. It would, however, require strong commitment by the government as well as concerned public and private sectors (ESCAP/FAO/UNIDO, 1998).

There has been no domestic production of any fertiliser in Nepal. All fertiliser requirements are met through imports. Until recently (1996/97), AIC had monopoly over fertiliser imports, including fertilisers received as aid, grant or purchases under loan. The quantities of fertilisers imported over the past 30 years in terms of nutrient weight are given in the following figure. Recently, HMG has introduced a policy to involve the private sector in supplying the fertiliser. HMG has also issued a Fertiliser Order in order to ensure the supply of quality fertilisers to the farmers (Box 2.4).

Figure 7. **A General Trend of Fertiliser Use in Nepal**
Source : Economic Survey, 1999

Box 2.4

Fertiliser Order

His Majesty's Government of Nepal has issued the Fertiliser (Control) Order, 1999 under which the Ministry of Agriculture (MOA) has the sole authority to execute the order. No person shall produce, import or distribute fertiliser which does not comply with the order.

The Fertilizer Order is aimed to supply quality fertilisers to farmers. A Fertiliser Advisory Board has been conceived in the Order in order to advise the MOA in the formulation of policies, priorities, specifications, quality control and statistics. A Fertiliser Unit is in operation in MOA to regularise and control the production, import and sale of fertiliser in Nepal.

2.10.3 Livestock

The interdependency among the three rural subsectors - farming, animal husbandry and forestry - is unique in the Nepalese hill farming system. Livestock contributes 31 per cent of the total agricultural GDP. It also provides farmyard manure/compost to farmland for maintaining soil fertility and draught power. Estimates indicate about 6.237 million livestock, 3.073 million buffaloes, 5.452 million goats, 0.911 million sheep and 0.605 million pigs in the year 1992/93. In 1999, livestock population has been estimated at 34 million. Over half of them are reared in hills, and one third in Terai. There is an increasing trend to rear livestock, except cattle. Livestock density has increased from 5.95/ha in 1981/82 to 7.4/ha in 1991/92. The production of meat, milk and milk products, and egg has substantially increased from 117.1 thousand mt., 711.5 thousand mt., and 219.6 million (number), respectively in 1982/83 to 185 thousand mt., 1072 thousand mt, and 440 million (number) in 1998/99 (MOF, 1999).

Meat production in FY 1997/98 increased by 3.677 per cent more in comparison to FY 1996/97 and reached 1,80,675 mt. Milk production in FY 1997/98 was 10,48,040 mt, an increase of 3.545 per cent as compared to the previous year. Likewise, egg and fish production both show an upward trend as compared to previous fiscal years. Eggs have increased by 4.615 per cent and fish by 7.181 per cent (MOF, 1999).

Estimates indicate that about three-quarters of all households keep cattle, while half of them keep buffaloes, goats and poultry. The number of livestock kept on farms has a negative association with the size of

holdings. Very small farmers cannot meet the fodder and forage requirements of their animals, resulting in the decline in livestock products. Thus, pressure on public forests and pastures is increasing in most parts of the country. However, this sector is growing fast. The Agricultural Perspective Plan (APP) argues that the growth rate of the livestock will increase from 2.9 per cent at the base period of the Plan to 6.1 per cent at the end of Plan, i.e., 2015 AD (APROSC and JMA, 1995).

Livestock production is dependent on the quality of forests and grazing lands. Open and over-grazing have contributed to land degradation. Uplanders repeatedly graze many of the pasture land in the mountains during winter season, while lowlanders do the same during the summer season. There are also unproductive livestock, which freely graze in the forestlands. In sum, the degradation of the land system and increase in the soil loss due to livestock pressure is clearly visible.

2.10.4 Fishery

Fish is a major source of protein. In the early 1990s the per capita consumption of fish was about 800 grams. Its production significantly increased from 4.3 thousand mt in 1982/83 to 24.86 thousand mt in 1998/99. Both pond and cage fisheries have been introduced in the Terai and the lakes. Cage fisheries have also been developed in major lakes and reservoirs such as Phewa Lake, Rupa and Beganas lakes, and Kulekhani hydropower reservoir. Estimates indicate that 19.8 per cent of the total lakes and 14.7 per cent of the total reservoirs are used for fish development activities. Farmers also practice fish raising in village ponds and irrigated paddy fields.

Fish production is sometimes hampered by high flood and sediment deposition in the ponds and the reservoirs. Discharge of untreated industrial effluents has also affected the fish population in natural water bodies. Increasing physical and chemical pollution in water bodies is a major concern for sustainable development of this sector.

In sum, agriculture will continue being one of the major sectors in Nepal's national economy. However, Nepal has become a food grain deficit country since the 1970s. The yield rate of most of the cereal crops is on the declining trend, primarily, due to loss of nutrient rich topsoil. Another factor may be the disproportionate use of agro-inputs such as chemical fertilisers and pesticides. Livestock production is also increasing at the cost of land degradation. This phenomenon is visible in the Middle Mountains. The problems of fodder, inferior breeds of crops and livestock, low yields and a

poor extension base are still significant. The recently implemented APP has emphasised irrigation, technology and fertiliser input, including a few high value commodities to accelerate the growth of farm products. The APP is designed to accelerate agricultural growth rate from about 3 per cent to 5 per cent per annum and achieve a six-fold increase in the growth of agricultural output per capita from the insignificant growth rate of 0.5 per cent to a rapid 3 per cent (APROSC and JMA, 1995). It also focuses on the growth of livestock sector and indigenous techniques of organic farming, including plant nutrient management. Although, species diversity in agriculture sector prevails, people tend to use only the high-yielding varieties.

The interdependency of agriculture, livestock and forestry has to be closely looked into in order to minimise land and forest degradation. It will help to increase land productivity and reduce the number of unproductive livestock. Efforts should also be made to promote the use of organic fertilisers and strengthen integrated pest management.

2. 11 Culture and Tourism

2.11.1 Cultural Heritage

Globally, Nepal is recognised as a country with rich cultural heritage. A long and complex link exists between human development culture and values. Heritage sites are of immediate aesthetic, architectural, historical or social significance. A management framework for its preservation must invariably accompany the building of a monument. Our ancestors not only built monuments, but also left behind a tradition of maintaining them through a system of 'Guthi' (trust), which performs socio-religious, cultural and educational activities. To perpetuate this system, founders voluntarily donated, either in cash or in kind, thereby enabling a regular upkeep of the monuments and other rituals and functions. In essence, the cultural continuity at local level is highlighted by 'Guthis'.

An inventory of heritage sites carried out in 1975 categorised 29 historical settlements, and 34 monumental zones in the rural areas. Cultural sites of immense importance have also been identified. During the process of becoming a party to the World Heritage Convention, Nepal listed seven cultural sites of universal importance in the World Heritage List in 1979. These sites are: *Bhaktapur, Patan and Hanuman Dhoka Durbar Squares, Swyambhunath, Bauddhanath, Pashupatinath, and Changu Narayan***.** Recently, *Lumbini* - the birthplace of Lord Buddha has also been included in the list.

A guideline for the identification, monitoring and management of heritage sites as well as a database has been developed. Over 1,250 heritage sites have been documented from 72 districts outside Kathmandu Valley. The Valley is also a repository of heritage sites of cultural importance as over 1,000 ancient monuments are scattered around it. Out of this, 888 monuments have been considered nationally important (CCNCR, 1990). HMG is committed to continuing the promotion of the traditional system of heritage management. Albeit, the conservation of national cultural and natural heritage sites is beyond the scope of the local Guthis, however, HMG institutions are involved in developing and implementing policies and programmes for their conservation.

In recent years these cultural sites, historical monuments and religious shrines have come under greater pressure, through a continuous process of encroachment and poor maintenance. For instance, the Buddha Stupa in Kathmandu suffered from increasing population pressure surrounding the Stupa. Cultural heritage is also facing challenges from different aspects of modern life. It is simultaneously threatened by nature, time and people. The fragility and vulnerability of cultural heritage is so pronounced that every year many important monuments are either defaced or encroached upon by unauthorised activities.

2.11.2 Tourism

Nepal's numerous sites of cultural and natural interest has attracted tourists. Tourists visiting Nepal are broadly of two categories - pilgrims and nature lovers. Pilgrimages are limited to urban and semi-urban areas, while nature-adventuring tourists prefer the hills, mountains and wilderness. In the late 1950s, only two thousand tourists visited Nepal. The number of tourists reached to 223,000 in 1986 and over 422,000 in 1998. The annual change in tourist arrival is over 10 per cent, except between 1987 to 1990 (MOTCA, 1997). However, the percentage of Indian tourists prevails high. Over 50 per cent of the tourists visit Nepal for holidays and pleasure, followed by over 20 per cent for trekking. Accordingly, tourism development facilities are also on the increase. The number of hotels has increased from 110 in 1986 to over 700 in 1998 with a corresponding increase in rooms. Over 60 per cent of this capacity lie within the Kathmandu Valley, with a considerable number of high standard hotels. The number of beds has also increased three times, from about 7,000 to 27,000, during the same period. The actual air seat has increased significantly as Nepal observed Visit Nepal in 1998. Similar growth has been recorded in the increase of travel,

trekking and rafting agencies. It is estimated that tourism sector has generated employment opportunity to over 200,000 people.

Tourism is one of the major sources of revenue in Nepal. The gross foreign exchange earning has increased from Rs. 2735.3 million in 1986 to Rs. 9881.6 million in 1998 and its contribution to GDP is 3.5 per cent (MOF, 1999). In order to enhance the image of Nepal as a tourist destination, Nepal prepared and implemented a Plan of Action under the theme "A Sustainable Habitat Through Sustainable Tourism" and " A World of its Own". The Visit Nepal '98 was regarded as an event of national significance, with the target of increasing the tourist number from 363,000 to 500,000; lengthening the average duration of stay from 11.3 nights to 12 nights; and enhancing the average spending per visitor from US$ 42 in 1995 to US$ 50 in 1998. Emphasis was given to improving the quality of current tourism products, developing eco-friendly value-based tourism products, and promoting domestic tourism (MOTCA, 1997).

Along with tourism development, a few environmental issues have emerged, particularly in the trekking areas. Demand of more firewood for heating and cooking purposes for the tourists and their support staff has accelerated forest degradation in areas where regeneration potential is very low. For example, over 10 support staff is required for a mountaineer. It is natural that they require more firewood for cooking and heating purposes. Although, HMG has introduced a mechanism to use the kerosene as an alternative energy, there is still a practice to use the firewood by the supporting staff. Furthermore, development of new forests through plantation requires long time. Trekking activities have increased the disposal of non-degradable items in the mountains. Thus, waste disposal and management issues are also on the increase. The Annapurna, Everest and Langtang areas are facing the problems of plastic, glass, foil, and batteries (ICIMOD and CRT, 1997). An estimation indicates that about 15 tons of waste remain to be gathered from the Mt. Everest Base Camp area (Warmer, 1996). Recently, Wilderness Annapurna -1999 collected about 1.5 tones of trash from the Annapurna area.

Figure 8. **A General Trend of on the Number of Mountaineers and Support Staff**

In view of the success of the Visit Year 1998, HMG has planned to celebrate the year 2002 as Destination Nepal for the promotion of tourism development.

In sum, Nepal is rich with well-known cultural heritages. Eight cultural sites are enlisted in the World Heritage List. Various monuments and cultural sites are managed by community-based organisations. However, owing to fast social transition, the traditional management systems have been eroding. Indigenous skills are being replaced and the quality of cultural sites is fast degrading.

Despite tourism being a major source of foreign exchange earnings, enough priority has not been awarded to environmental issues which have arisen due to unregulated tourism activities and inadequate waste management facilities in the mountain areas.

2.12 Environmental Awareness and Communication

HMG recently introduced formal environment education at primary and secondary levels, and has plans to introduce it at the tertiary level also. Primary school curricula comprise of environment and health components, whereas tertiary level environmental science introduced by both Tribhuwan University and Kathmandu University is aimed at producing skilled human resources. Pokhara University has also granted permission to private institutes to conduct environmental training programmes. Environmental aspects have also been included in various non-formal and informal education courses, with primary focus on natural resources management, health and sanitation.

Various forms of media are involved in creating public awareness. These include group meetings, mass media, personal contacts as well as a combination of all of these. Media is used to serve specific needs of the target groups. Communication and information messages are designed separately for urban, semi-urban and rural areas with due consideration to environmental problems.

The Ministry of Population and Environment is implementing a number of public awareness activities. These activities include, *inter alia*, weekly radio programmes, teleserials and spot announcements. Newsletters, storybooks, informative booklets and environmental journals are also regularly published. In this fiscal year 1999/2000, the Ministry is implementing public awareness activities through the mass media, such as the radio, television, cinema halls the print media. Informal group meetings, training workshops and seminars are also being organised. The Ministry is also implementing advocacy programmes aimed at policy-makers and journalists. Besides, a number of organisations are involved in creating public awareness about environmental issues. The following table gives a glimpse of public awareness activities in Nepal.

Table 2.12.1 **Public Awareness Activities**

Radio Programmes	Regular programmes, special/occasion programmes and spot announcements.
Inter-personal Communications	Seminars, workshops, training, talk programmes, essay contests, special youth and women-specific programmes.
Print Materials	Booklet, pamphlet, newsletter, feature article, magazine, wall newspapers, wall calendar/diary, manual and information kits.
Audio -Visual	Film/slide production and shows, photo/art/slide exhibition.
Television Programmes	Documentary, telefilm, occasional programmes and spot announcements.
Indigenous Media	Drama, comedy and folk songs.
Public Advertising	Mass rallies, display boards, stickers and printed vests, T-shirts.

Environmental awareness activities have made a positive contribution to resource management, health care and adoption of conservation measures in infrastructure projects and programmes. Various organisations have launched conservation extension activities as an integral part of their programme implementation. As recognition for their contributions special awards such as the National Forest Conservation Award, have also been instituted to recognise individuals and organisations involved in public awareness activities. The Ministry of Population and Environment has also

started to award organisations, particularly on World Environment Day (5 June), in recognition of their work on environmental management.

Interpersonal communication or radio programmes are considered more effective than any other form of media. However, the importance of print materials cannot be underestimated. Literacy level of Nepalese has considerably increased and reached about 57 per cent for males and 32 per cent for females in general, and as high as 77 per cent for boys and 56 per cent for girls between the age of 11 to15 years. Environmental education and communication programmes launched by both governmental and non-governmental organisations have also contributed towards understanding and acting for environment management.

Chapter Three
POLICY, LEGISLATION AND INTERNATIONAL COMMITMENTS

Following the reinstatement of democracy in 1990, His Majesty's Government of Nepal (HMG/N) revised the environment friendly policies and programmes. While previous policies relied mainly on command and control instruments, more recently economic instruments are considered equally important in order to improve environmental conditions. To address environmental concerns and issues described in Chapter Two, the following section deals with policy and legal measures and its implications on environment management. Highlights of international commitments and emerging environmental issues are also included in this chapter.

3.1 Policy Initiatives

Development planning exercise, which was initiated in the mid-1950s, focused mainly on natural resources utilisation, agriculture production, sanitation and sewerage facilities, and infrastructure development. Nepal started its planned process of development in 1956, when the *First Five Year* Plan (1956-'61) was first launched. The main objective of this plan was to increase agricultural production and generate more revenue from forests. During this plan period, the *Forest Nationalisation Act, 1957* was enacted and forests were nationalised.

The *Second Five Year Plan* (1962-'65) put emphasis on increasing food production. The following environmental concerns were also included in this plan:

- survey of natural resources and activities in industry, electricity, irrigation and transport;
- preparation of management plans for forestry for selected districts, particularly for afforestation, forest demarcation, construction of fire-lines, forest roads, and promotion of forest-based industries.

The *Third Five Year Plan* (1965-'70) incorporated the following environment related policies and programmes:

- resettlement programme in Terai to reduce population pressure in the hills;

- ?? a cadastral survey for land reform;
- ?? forest survey;
- ?? protection of temples and historical places;
- ?? preparation of a physical plan for Kathmandu Valley;
- ?? water quality analysis;
- ?? sedimentation and water flow recording in Terai; and
- ?? initiation of master plans for drinking water and sewerage.

The prime thrust of the *Fourth Five Year Plan* (1970-'75) was to mobilise internal resources and concentrate on a regional concept of development. Sectoral policies of the Plan, related to environment in this Plan were:

- ?? delineation for major agricultural areas;
- ?? reclamation of forest land for more agricultural production by means of resettlement programmes;
- ?? increase revenue from forestry sector and scientific management of forest resources;
- ?? soil and land use surveys in selected districts;
- ?? soil conservation in Kathmandu Valley watershed; and
- ?? establishment of a laboratory to study the chemical composition of water.

The *Fifth Five Year Plan* (1975-'80) introduced the concept of ecological balance and economic development by giving primary emphasis to conservation and development of watersheds in the hills. It was during this plan period that land use and water resource development policies were first introduced. Likewise, the *National Forest Policy,1976* was also formulated. This Plan emphasised:

- ?? conservation of flora and fauna;
- ?? establishment of industries outside the densely populated areas;
- ?? development of new tourist places with due consideration to the environment;
- ?? women's participation in forestry, agriculture, health and water resource development activities.

The *Sixth Five Year Plan* (1980-'85) gave emphasis to the theme "Conservation" during the implementation of its development programmes. This policy further emphasised the need for:

- ?? population control;
- ?? soil conservation and watershed management;

- survey of endangered flora and fauna species;
- reduction of over-dependence on agriculture;
- environment impact assessment (EIA) of development projects; and
- review of rules and regulations concerning the environment of the urban areas.

Environment friendly polices were further elaborated in the *Seventh Five Year Plan* (1985-'90) and for the first time a national level policy on environment management was incorporated in this Plan. Emphasis was also laid on the importance of public participation in the decision-making process and the role of women and non-governmental organisations in environment management. The National Conservation Strategy as well as the Master Plan for Forestry Sector were also endorsed and their implementation initiated during this plan period.

The *Eighth Five Year Plan* (1992-'97) re-enforced environment management policies with specific reference to sustainable economic growth and poverty alleviation. The Plan emphasised, *inter alia*, the need for internalising the Environmental Impact Assessment (EIA) system, particularly in economic development plans and programmes. Improvement of legislative measures, and the promotion of environmental awareness at different levels were also emphasised in the Plan. A National Environmental Policy and Action Plan (NEPAP) was prepared in 1993 to facilitate integration of environmental aspects in the development process. This was prepared in response to the growing environment conservation awareness and the need to maintain a balance between the environmental conservation and development activities (EPC, 1993). During this period, the Master Plan for Irrigation and Livestock was also prepared. Environmental aspects were also incorporated into the hydropower, irrigation and industrial development policies. Preparation and implementation of the Agriculture Perspective Plan (APP) was also initiated during this Plan period. In addition, the period also witnessed incorporation of environment management in the election manifesto of political parties.

The current *Ninth Five Year Plan* (1997-2002) encompasses the principles of sustainable resource management. Realising the differences between urban and rural environmental problems, vis-à-vis utilisation of common resources, the plan appreciates the community forest management programmes. Retro-inspecting the Eighth Plan, following are some major objectives of the Ninth Plan with regard to the environment sector:

- Institutional strengthening of line ministries in environmental field;

- Integrated approaches for development and environment;
- Legal provision for national resource conservation;
- Expansion of the scope of biological diversity;
- Scientific forest management;
- Pollution control programmes;
- Involvement of private or civil society in management of municipal wastes; and
- Economic incentive and disincentive measures for pollution control.

Some policy directives of the Ninth Plan are:

- Priority to environmental programmes which involve women and poverty stricken classes of people;
- Special programmes for environment conservation in remote areas;
- Involvement of non-governmental organisations in environmental education;
- Training and research on pollution control, solid waste management, etc.;
- Development of environmental management information system; and
- Implementation of environmental standards.

The Ninth Plan also discusses environment specific issues, and programmes and activities have been planned in relation to these areas. The Plan has emphasised the harnessing of solar energy by establishing 38,000 photovoltaic systems in remote area households. Moreover, about 300 solar dryers will be set-up in different rural communities. The plan also has a target of establishing micro-hydro projects worth 5,200 kilowatt (kW). Similarly, it envisages spreading the biogas (methane gas) plants to a total of 90,000 during this period.

The Ninth Five Year Plan explicitly indicates that resource mobilisation, conservation and management of forests will be at par with the demand and supply of forest products. For long term purposes, implementation of forest management programmes is envisaged in the plan. It also emphasises the involvement of private sector and introduction of market economy for sustainable forest development.

As per the APP objectives, increased agro-inputs such as chemical fertilisers and pesticides will be required to increase the per unit agro-yield. While these have certain negative environmental impacts, new strategies

are being taken into consideration in the integrated plant nutrient management (IPNM) and the integrated pest management (IPM) systems.

The need for air and water pollution control has also been addressed in the *Ninth Five Year Plan*. The Plan has also stressed the conservation of the national cultural heritage by planning for an ethnographic museum.

3.2 Action Plans

Nepal started the preparation and implementation of the Environment-related Action Plans (EAP) after her participation in the *United Nations Conference on Environment and Development* (UNCED) held at Rio de Janeiro in 1992. In response to the growing awareness about the importance of mainstreaming environmental programmes in the development planning and implementation, Nepal prepared the (Nepal) Environmental Policy and Action Plan (NEPAP) which was endorsed by the Environment Protection Council in 1993. Based on previous assessments of environmental issues, challenges and opportunities, a number of actions were proposed in the following five prominent areas.

1. Sustainable management of natural resources;
2. Population, health and poverty;
3. Safeguarding the national heritage;
4. Mitigating adverse environmental impacts; and
5. Legislation, institutions, education and public awareness.

Since 1993, several institutions have continued the incorporation of selected activities in programme planning and implementation. However, much of the actions still remain to be implemented.

Nepal also prepared a National Plan of Action as part of a national report to the City Summit (HABITAT II) held in Istanbul from 3 to 14 June 1996. This Action Plan identifies the priority issues related to shelter, urban poverty and planning, environmental management, local governance and conservation of cultural heritage. Various actions have been proposed in these broad sectors which also include monitoring and evaluation as well as implementation mechanism. The Action Plan clearly documents the issues, objectives, activities and time frame and responsible agencies for implementation. HMG is implementing the selected activities of this Plan in a phased manner.

The Ministry of Forests and Soil Conservation is currently finalizing the National Biodiversity Action Plan (NBAP) under the GEF-funded

Biodiversity Conservation Project with the objectives of providing a systematic and strategic approach to biodiversity protection in accordance with the Convention on Biological Diversity, to which Nepal is a Party since February 1994. This Action Plan identifies key biodiversity issues, and documents a number of priority programmes in the areas of agriculture, community forests, livestock genetics, rangeland, protected areas, wetland, and non-timber forest products. The NBAP proposes special programmes to address cross-sectoral issues on biodiversity. A time frame and estimated cost is also proposed therein.

The Ministry of Population and Environment (MOPE) has also recently prepared a five-year Strategic Plan with a view to mainstreaming environmental aspects in socio-economic development plans and programmes. This Plan outlines MOPE's mission, goals, strategies, priority activities and outputs. The recommended mission of the Ministry is "*to promote environmentally sound and sustainable development and thereby safeguard human health*". This Strategic Plan aims to integrate environmental instruments in economic development planning and decision-making; develop and strengthen human resources (knowledge based and technical/scientific) and institutions; institutionalize stakeholders' participation on environmental management; and minimize pollution load through the enforcement of environmental legislation and standards.

In order to achieve these desired outputs, 21 activities and 84 sub-activities have been identified for the five year period. Effective implementation of this Plan will likely mainstream the integration of environmental aspects in programme planning, design and implementation at the cross-sectors.

3.3 Environmental Legislation

Environmental legislation is a key to the promotion of environment management activities in a democratic society. Prior to the reinstatement of democracy in 1990, sectoral policies were directed to the utilisation of natural resources for infrastructure development, even at the cost of environment. Environmental provisions in earlier Constitutions, such as in the 1990 Constitution of the Kingdom of Nepal, were virtually absent. However, the present Constitution of Nepal, 1990 clearly indicates the need for environmental conservation in the 'Directive Principles of the State'. It states that "*The State shall give priority to the protection of the environment of the country and also prevent damage due to physical development activities by making people conscious of environmental cleanliness, and by making special arrangements for the protection of rare animal species, forest and vegetation*" [Article 26(4)]. According to the

Constitution, the State shall adopt a policy for mobilising natural resources of the country in a manner which will be suitable, useful and beneficial to the interests of the country [Article 26(3)]. In accordance with the Article 64 of the Constitution, the House of Representatives (Lower House) has constituted an Environment Conservation Committee to deal with environmental issues.

Legislation plays a significant role in meeting environmental obligations, creating public awareness and resolving conflicts. Various sectoral laws enacted after 1990 contain provisions to institutionalise an *ex ante* consideration of the environment in development planning and their subsequent implementation. There are a number of sectoral laws dealing directly or indirectly with environmental issues. Some of the complementary Acts are briefly summarised in Table 3.1 to provide an insight into the spectrum of legislative provisions related to environment.

Following the establishment of the Ministry of Population and Environment (MOPE) in September 1995, the *Environment Protection Act (EPA), 1996* and the *Environment Protection Rules (EPR), 1997* came into existence. This environmental legislation emphasises environment conservation and management through internalisation of the environment assessment system, pollution control and prevention, conservation of natural heritage sites, operation of environmental funds, additional incentives to minimise pollution, and compensation for environmental damages. Emphasis has also been laid on carrying out environmental impact assessment of the prescribed development projects and programmes. More than 200 types of developmental activities must follow the environmental assessment process. MOPE reserves the right to accept or reject the environmental impact assessment report(s) of the prescribed proposal(s), whereas the concerned ministries could approve the Initial Environmental Examination (IEE) report(s). Regarding pollution management, the *EPR, 1997* envisages an environmental permit system, and the polluters shall have to comply with the environmental standards. A maximum penalty of 0.1 million rupees (1 US $ = Rs. 69) may be imposed upon those who implement projects without receiving approval for the IEE/EIA report (MOPE, 1997).

The *EPA, 1996* also empowers the Environmental Inspector to inspect and report on the implementation status of agreed upon conditions. The *Act* also empowers HMG to constitute the Environment Protection Council and provide policy guidance and suggestions to the government. The Council will consist of environmental experts and representatives of the recognised political parties at the national level. The *EPA, 1996* and *EPR, 1997* have

emphasised public consultation process during the preparation and approval of the EIA reports (MOPE, 1997) (Box 3.1).

Table 3.1 **Environment-related Provisions in Some Contemporary Acts**

Acts	**Relevant Provisions**
Local Self-Governance Act, 1998	Specific environmental scope of work for DDC, VDC and TDC comprising local level environmental planning; forest and biodiversity conservation, land-use management, pollution control, public sanitation, etc.
Environment Protection Act, 1996	Maintain clean and healthy environment and contribute to sustainable development
Forest Act, 1992	Conserve and manage forest and biodiversity
Water Resources Act, 1992	Promote environment assessment, water quality standard, and avoid significant impacts on local environment in the course of water use
Electricity Act, 1992	Avoid environmental effects during electricity generation and transmission
Vehicle and Transport Management Act, 1992	Regulate vehicular exhaust emission according to the standard
Industrial Enterprises Act, 1992	Promote the adoption of industrial pollution control measures, including incentive and disincentive provisions
Pesticide Act, 1991	Regulate the use, production and distribution of pesticide
Labour Act, 1991	Adopt preventative and curative measures for occupational health and safety
Solid Waste (Management and Resource Mobilisation) Act, 1986	Ensure solid waste management through the collection, transportation, recycling, disposal, and the classification of hazardous wastes
Soil and Water Conservation Act, 1982	Ensure soil conservation through land use regulation
King Mahendra Trust for Nature Conservation Act, 1982	Generate fund and manage the nature with people's participation
Tourism Act, 1978	Minimise environmental pollution during mountaineering activities
National Parks and Wildlife Conservation Act, 1973	Declare and manage national parks, wildlife reserves and conservation areas

Box 3.1

Public Consultation on EA: A Legally-binding obligation

The *Environment Protection Act (EPA*), *1996* obliges the approving agency - the Ministry of Population and Environment - to make necessary arrangements to open the EIA report for the general public to render opinions and suggestions. The *Environment Protection Rules (EPR),1997 (amendment 1999)* further elaborates the public consultation process in order to ensure the participation of different stakeholders right from the scoping to the approval processes.

The *EPR, 1997* obliges the proponent to issue public notice on the contents prior to the preparation of a scoping report. Once the draft EIA report is prepared, based on the approved Terms of Reference (TOR), the proponent should conduct a Public Hearing at the project site.

Following submission of the EIA report to the Ministry of Population and Environment (MOPE), it should be made public. The MOPE has to legally approve the EIA report within 60 days upon receipt.

These legal provisions are meant to enhance the participation of different stakeholders right from the project inception to the implementation of the proposal.

The *Forest Act, 1992* and the *National Parks and Wildlife Conservation Act, 1973* (amendment 1993 with the inclusion of buffer zone concept) have been found effective in involving local people in forest management and species conservation. A legal provision on benefit sharing has also encouraged the local people in species conservation and has helped resolve conflicts between parks management and the people living in and around the area to some extent (Box 3.2).

Most of the legal provisions on environment management are very new and while some require the setting of environmental standards others require extended rules and regulations for enforcement. These regulations have, however, opened avenues for developing and/or amending other measures for environment management.

Box 3.2

Conflict Resolution Through Benefit Sharing

Eight national parks, four wildlife reserves, one hunting reserve and three conservation areas have ensured, *in situ,* conservation of biological diversity in about 18 per cent of the total area of the country. Various programmes have been launched to maintain the habitat and to increase the number of endangered, threatened and vulnerable wildlife. Continuous and untiring efforts by the government along with its conservation partners, both international and national NGOs as well as the community, have proved successful in bringing about positive changes in the conservation of biological species.

The new legal arrangement on buffer zone management, based upon the *National Parks and Wildlife Conservation Act, 1973 (*amended 1993) has opened new avenues in resolving conflicts between the park management and the local people, especially, conflicts related to access or use of forest resources to meet the requirements of the people living near protected areas, and in preserving agricultural yield and livestock from the wild animals.

The *Act* also introduced the concept of revenue sharing and clearly spelled out that 30 to 50 per cent of the total revenue generated in the protected areas will be used for community development activities. This will be done to promote local people's participation in park management and ultimately in biodiversity conservation. Accordingly, a *Buffer Zone Management Rules, 1996* is also in place. This concept has also prompted Nepal to strengthen eco-tourism in the protected areas. The benefit sharing mechanism has contributed a lot to resolving the prevailing conflicts on species conservation.

Source: MFSC, 1997

3.4 International Commitments

The international community is playing an important role in the conservation of environment through various measures. Cross-sectoral environmental issues are frequently addressed and national actions promoted through the adoption and implementation of environment related resolutions enshrined in international conventions. Nepal has also joined these international efforts by either being Party to several Conventions or by participating in the legally non-binding instruments such as Agenda 21.

In June 1972, Nepal participated in the United Nations Conference on 'Human Environment' held in Sweden. The Conference prompted Nepal to initiate several environment-friendly activities and rehabilitate its degraded

lands. It has since continued to participate in several meetings and conferences. Nepal actively participated in the Earth Summit in June 1992, which adopted Agenda 21 as a blue print of actions on environment and development for the 21st century. Nepal has also re-emphasised its plan to attain the goals of sustainable development, embodied in "Our Common Future." Nepal has also been actively participating in regional environment management efforts. It is member of various regional inter-governmental bodies such as South Asian Co-operative Environmental Programme (SACEP) and South Asian Association for Regional Co-operation (SAARC), both of which aim at fostering relationships and working for the management of the environment, individually or jointly.

3.4.1 Legally Binding Instruments

The past two decades have witnessed the birth of a considerable number of international Conventions and Agreements in the field of environment conservation. Several international environmental instruments were adopted to address a wide variety of environmental problems such as transboundary air pollution, protection of the ozone layer, transboundary movements of hazardous wastes, trade in endangered species, protection of international waterways, climate change, conservation of biological species and combating desertification. In accordance with the commitments in the international fora, Nepal has ratified or has access to 16 environment related Conventions and Agreements. However, despite HMG being bound under the Nepal Treaty Act to take legislative measures for the implementation of treaties to which Nepal is party (Belbase, 1997), a significant gap between international environmental instruments and their implementation at the national level is apparent. This may be due to the absence of a specific agency to implement these treaties.

As a Party to these Conventions, Nepal has to prepare and implement national action programmes to bring about change in the consumption pattern, ensure the conservation of biological species and/or forests, and implement land improvement activities. Some environmental obligations of the Conventions and Agreements, to which Nepal is a Party, are presented in Table 3.2.

Nepal is also Party to the Convention on the High Seas; Treaty Banning Nuclear Weapon Tests in the Atmosphere, Outer Space and Under Water; Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space including the Moon and Other Celestial Bodies; 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; United Nations Conventions on the Law of the Sea; and the International Tropical Timber Agreement.

Table 3.2 **Obligations of the Selected Conventions**

Name of the Conventions	**Entry into Force in Nepal**	**Major Obligations**
UN Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa, 1994	13 January 1997	?? Combating desertification and mitigating the effects of drought by adopting integrated approach to address the physical, biological, and socio economic aspects of the processes of desertification and drought; and ?? Integration of strategies for poverty eradication, and preparation and implementation of the National Action Programmes
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, 1989	13 January 1997	?? Protection of the environment and adoption of measures to safely transport, dispose and manage hazardous wastes; ?? Controlling illegal traffic of hazardous wastes
Vienna Convention for the Protection of the Ozone Layer, 1985	4 October 1994	?? Adoption of appropriate measures for the protection of human health and the environment resulting from modifications in the ozone layer; ?? Adoption of measures, procedures and standards to minimise the use of ozone depleting substances; and ?? Initiation and co-operation to carry out research and scientific assessment on processes that may affect the ozone layer
United Nations Framework Convention on Climate Change, 1992	31 July 1994	?? Stabilisation of green house gases concentrations in the atmosphere and protection of the climate system; ?? Precautionary measures to anticipate, prevent or minimise the causes of climate change; ?? Formulation of national policies and corresponding measures; and ?? Promotion, co-operation and facilitation in research and public awareness on climate change and its effect

Name of the Conventions	**Entry into Force in Nepal**	**Major Obligations**
Convention on Biological Diversity, 1992	21 February 1994	?? Conservation and sustainable use of biological diversity, and equitable sharing of benefits; ?? Preparation and implementation of national strategies, plans or programmes for the conservation and sustainable use of biodiversity; and ?? Conservation in *in-situ* and *ex-situ* conditions, and promotion on biotechnology and genetic research
Agreement on the Network of Aquaculture Centers in Asia and the Pacific, 1988	4 January 1990	?? Expansion of aquaculture development through multi-disciplinary research on selected aqua-farming system and transfer of technologies; and ?? Establishment of a regional information system, and train and upgrade core personnel for national aquaculture planning, research, training, extension and development
Convention on Wetlands of International Importance Especially as Waterfowl Habitat, 1971	17 April 1988	?? Designation of wetlands of national and international importance and conservation, management and wise use of migratory stock of waterfowl and their habitats
Convention for the Protection of the World Cultural and Natural Heritage, 1972	20 September 1978	?? Adoption of effective measures for the protection of cultural and natural heritage through national and international co-operation
Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973	16 September 1975	?? Protection of natural ecosystem including wild fauna and flora; and ?? Regulation on trade, import and export of species listed in Appendices
Plant Protection Agreement for the South East Asia and Pacific (as amended), 1956	12 August, 1965	?? Prevention on the spread and introduction of pests of plants and plant products, and promotion of measures for their control during import and export

Source : MOPE, 1998.

Since the last three decades, efforts for species conservation in the protected areas have also brought about a change in the population of a few of the endangered wild animals. The CITES played a major role in

contributing towards adoption of stringent measures for the conservation of the rhinoceroses. (Box 3.3).

Box 3.3

Rhino Population Increased

His Majesty's Government (HMG/N) along with its partner organisations has conducted intensive conservation efforts in protected areas. This has significantly increased in the population of the protected wildlife. Current estimates indicate tiger population to be within the range of 150 to 200; wild buffaloes - 100 to 120; black bucks - 100 to 110; Bos gauros - a minimum of 190; and wild elephants - 40 to 50. In addition, over 450 crocodiles – legally protected species, have been released in three major rivers – Koshi, Karnali and Narayani rivers.

In April 2000, HMG and its partner organisations carried out a Count Rhino Programme and confirmed that the population of Greater one-horned rhinoceroses (*Rhinoceros unicornis*) increased from about 90 in the late 1960s to 612 in 2000. Of them, 544, 67 and 1 rhinos were recorded in the Royal Chitwan National Park (RCNP), Royal Bardiya National Park (RBNP) and Royal Suklaphanta Wildlife Reserve (RSWR) respectively. The last census, conducted in 1994, had recorded 446-466 rhinos in and around RCNP with the annual growth rate of 3.7 per cent. The 2000 census shows an annual growth rate of 3.88 per cent.

Although rhinos prefer the grassland habitat, a good number of them were found in the buffer zone of the RCNP. In RBNP, they were recorded in the Karnali flood plain and the Babai Valley of the park. Because of good habitat in the later national park, HMG has successfully translocated a total of 52 rhinos from RCNP to RBNP.

These protected areas are the representative ecosystems of the Indo-Malayan bio-geographic realm. RCNP, Nepal's first protected area, is also listed as a World Heritage site.

Such encouraging increase in the number of protected wild animals has motivated various agencies to strengthen efforts for species conservation.

Several seminars and meetings have been organised and studies carried out to implement the obligations of these Conventions. Nepal is preparing an Action Plan in accordance with the Convention on Biological Diversity (Box 3.4). Nepal is also planning to prepare the National Action Programmes (NAP) as per the UN Convention to Combat Desertification. In this process, HMG organized a national seminar on *Desertification and Land Improvement,* with the assistance of the Secretariat of the UN Convention to Combat Desertification, in order to share experiences and identify priority issues for NAP. Furthermore, Nepal has recently prepared

the national report on the status of implementation of the UN Convention to Combat Desertification.

Box 3.4

National Biodiversity Action Plan Prepared

In accordance with the Convention on Biological Diversity, Nepal is finalising the National Biodiversity Action Plan Project under the component of the GEF-funded Biodiversity Conservation Project. The Action Plan aims to develop systematic and strategic approaches, provide specific priority programmes and actions by recognising existing initiatives and responsibilities, and identify needs and constraints for biodiversity conservation. The plan provides a comprehensive strategy for co-ordination of the various stakeholders of biodiversity, including, wildlife, forestry, agriculture, and communities at large to implement the prioritised conservation needs of the country. The Plan has also identified priority areas requiring conservation in the areas of forestry, wildlife, wetland and agriculture diversity (crops and livestock). Successful implementation of this Action Plan will help conserve local biodiversity as well as meet international obligations.

3.4.2 Legally Non-Binding Instruments

A number of international conferences and meetings have adopted environment-related principles and recommendations to improve the environmental quality. Though legally non-binding, however, it is the moral responsibility of the Party country to implement them through integration into the national programmes. In this context, the principles adopted in the Stockholm Conference and Rio Earth Summit are of major importance. Agenda 21 of the Earth Summit and the authoritative statement of principles for a global consensus on the management, conservation and sustainable development of all types of forests enable and facilitate a country to prepare and implement environment friendly activities. In accordance with the spirit of these principles, Nepal has developed and implemented numerous environmental policies and programmes. HMG's National Environmental Policy and Action Plan (NEPAP), 1993 has embodied some of the concerns which were prepared after the Rio Earth Summit.

Nepal has accorded high priority to implementing these Conventions and legally non-binding instruments. However, it has yet to develop and implement all the Convention resolutions through the development of strategies and regulatory measures.

Chapter Four
ACTIONS AND EMERGING ISSUES

Realising the emergence of environmental problems along with the socio-economic development, HMG has taken a number of steps to minimise the adverse environmental impacts. This Chapter highlights the development of environmental institutions, some achievements and Ikely emerging issues.

4.1 Environmental Institutions

Institutions for establishing database on natural resources in Nepal dates back to the early 1950s. However, since the 1980s institutional reforms have been carefully introduced to include environment policies at different hierarchies, particularly at sectoral level. These reforms prompted integration of environmental aspects in sectoral plans and in implementation of selected activities. In 1974, a National Committee on Man and Biosphere was established and environmental activities were initiated. In the early 1980s, the National Resources Conservation Commission was established to integrate natural resources issues in sectoral programmes. In 1987 an Environment and Resource Conservation Division was established in the National Planning Commission Secretariat to integrate environmental issues in development planning. Similarly, a Council for the Conservation of Natural and Cultural Resources was established in 1990 and in 1992 the Ministry of Forests and Soil Conservation was renamed as the Ministry of Forests and Environment. During the process of institutional evolution, other agencies later replaced these institutions.

Ex ante consideration and integration of the environmental aspects in socio-economic development process was further emphasised and facilitated by the establishment of Environment Protection Council in 1992, under the chairmanship of the Rt. Hon'ble Prime Minister. The Council is an advisory body and is represented by concerned ministers, high-level administrators, representatives of NGOs, and the private sector and professionals.

Various other organisations are also mandated to implement environment conservation activities. Among others, the Parliamentary Committee on Environment Conservation oversees the actions of the government and provides advice and directives on environment related issues. The Ministry

of Forests and Soil Conservation, and the Ministry of Agriculture and Cooperatives, with their respective departments and district offices implement activities in the green sector, whereas the Ministry of Industry, Commerce and Supply, Ministry of Physical Planning and Works, Ministry of Labour and Transport, and the Municipalities are concerned with minimising environmental pollution.

The Ministry of Population and Environment (MOPE), established on 22 September 1995, is primarily responsible for formulation and implementation policies, plans and programmes. MOPE is also responsible for preparing environment related Acts, Rules and Guidelines; conducting environmental surveys, studies and researches; disseminating information and carrying out public awareness programmes. It also performs the functions of monitoring and evaluation, development of human resources and acts as a national and international focal point in the domain of population and environment (MOPE, 1996). The major agencies with environment related responsibilities are presented in Annex 10.

Various non-governmental organisations, local clubs and community-based organisations (CBOs) also implement conservation programmes and/or raise public awareness, individually or jointly. Activities of the NGOs/CBOs are observed as an effective medium at grassroots levels.

In Nepal, the central level institutions, i.e., the ministries are basically policy-making bodies, while the departments and the district level organisations play the role of implementing the activities. The government's liberalisation policy will further necessitate the integration of the environmental aspects into development proposals. Despite these efforts, there still exists a tendency of maintaining that environment is automatically managed once environmental studies are conducted. To bring about change in such an approach, concerted effort is required for effective implementation of the study findings. Only then can positive change in environmental quality be brought about.

4.2 Economic Instruments

Along with policy and legal measures, environmental management is also possible through the introduction of economic tools and instruments to attract various stakeholders to comply with the set standards. Though environmental quality standards are yet to be developed, few of the economic instruments recently introduced would help minimise environmental damage. Macro-economic policies could also generate environmental problems. For example, the objectives of high economic

growth, currency devaluation, increase in government expenditures, and subsidies would exert pressure on natural resources which would have long-term impact on the well being of people.

In order to contribute to the national development as well as environmental improvement, various economic adjustments have been introduced. A few of them would accelerate environmental impacts while others would minimise them. Subsidies on gobar gas (methane) plants in rural areas are likely to have positive impacts on the environment, as majority of the local people depend on firewood to meet their energy demand. It would also minimise indoor air pollution. The government has introduced the policy of providing interest free loans with a repayment period of seven years and a direct subsidy of NRs. 5,000 per plant through the Agriculture Development Bank (ADB/Nepal). This incentive is estimated to save about 4.8 to 6.5 tons of fuelwood annually per household. Similarly, occurrence of chronic bronchitis and upper respiratory tract infections, which largely occur in the rural areas due to burning of firewood, would also be minimised. The policy of subsidy on kerosene would also contribute towards reducing pressure on forests for fuelwood.

The *Environment Protection Act, 1996* provides additional concessions and facilities to encourage industries and enterprises to adopt technologies and processes that would minimise negative impacts on the environment. The industrial policy also promotes the use of cleaner technologies to increase efficiency in resource use. The *National Parks and Wildlife Conservation Act, 1973* (amended in 1993) provides a special provision to allocate 30 to 50 per cent of the total revenue generated in the protected areas for community development. This legal provision facilitates the involvement of local people in species and ecosystem management and community development. Promotion of community forests also directly benefits local people such as forestry user's groups. By meeting the demand for forest products, they can generate and use the income accrued for community development. The *Forest Act, 1992* (amendment 1998) encourages the forestry users groups to allocate 25 per cent of the total income generated into the community forests for their development and management. These recent economic instruments are expected to bring about positive changes in socio-economic conditions and environmental management.

Similarly, the *Fiscal Act, 1999* has provided tax incentives for the production of electricity, gas or battery operated vehicles or for the import of the necessary parts of such vehicles. As per the provisions of this Act, the owners who cancel the registration of the diesel or petrol-operated three-wheelers plying in the Kathmandu Valley or stop the movement of

such vehicles in the Valley receive 75 per cent tax exemption in the current fiscal year 1999/2000 if they intend to import 10 to 15 seated vehicles except cars, jeeps and pick-ups or vehicles having over 10 ton GVW for providing public transportation facilities. Additional 10 per cent tax exemption has been provided for the import of microbuses which comply with the EURO-1 standard. Furthermore, legal provisions have been made to generate finances for environmental management and pollution control by imposing pollution tax on diesel and petrol prices. In addition, the commercial firms are required to get prior approval of the Ministry of Population and Environment while importing scraps of cloth, metal and plastics or equipment.

> Effective from mid-September 1999, HMG has prohibited the movement of diesel-operated three-wheelers in Kathmandu Valley, Pokhara Sub-Metropolitan City and Lumbini area with a view to minimising air pollution. The owner of such vehicle who intends to import 10 to 14 seated microbus which uses less polluting alternative energy, such as compressed natural gas or liquefied natural gas, are provided with 99 per cent tax exemption and full VAT exemption.

HMG, through its budget speech of fiscal year 2000/2001 has imposed excise duty on bricks. HMG has levied excise duty on polythene bags based on the size of the micron. HMG has prohibited the production of alcohol in plastic pouch and import of all vehicles which do not comply with the Nepal Vehicle Mass Emission Standards, 2056 (MOF, 2000).

Although these fiscal measures and economic incentives affect revenue collection, they will largely contribute to promoting the national welfare by preserving the environment.

Integration of environmental concerns with economic policies is a challenging task for a developing country like Nepal. The effective implementation of environmental policies, rules and regulations have thus far been limited due to weak institutional structure and associated high costs. In this context, potentially cost-effective solutions such as market-based measures, and a policy of mixed regulations and incentives are recognised as major tools for integration of environmental policy. A matrix of environmental policies and strategies will further check the contemporary anomalies of policies and market (Table 4.1).

Table 4.1 **A Matrix of Environmental Policy and Strategy for Nepal**

	Policy/Strategy	**Relevant environmental sectors**
1. Incentive mechanism		
i. Using market	Subsidy reduction	e.g. Import of chemical fertilizers
	Targeted subsidies	e.g. Municipal and industrial pollution management, industrial energy efficiency, rangeland conservation, forest management, organic fertiliser promotion
	User fees	e.g. Municipal solid waste management, combine wastewater treatment system
	Deposit refund system	e.g. Mountaineering teams, industrial packaging materials
	Environmental taxes	e.g. Pricing of use of water resources at different levels, pollution tax including ozone depleting substances, biologically-non-degradable items, pesticides and insecticides
ii. Creating markets	Property rights/ Decentralisation	e.g. District/Village Development Committees to manage environmental resources at local level
	Tradable permits	e.g. Industrial pollution control/management at Industrial Districts
	International offset system	e.g. Timberline and Churia conservation schemes to safeguard the Himalayas, soil and watershed conservation and carbon sequestration
2. Administrative mechanism		
i Environmental regulation	Standards	e.g. Emission, effluent and other physical standards,
	Bans	e.g. Import of toxic/hazardous substances as indicated in the Basel Convention, illegal trade of wild animals as mentioned in the CITES
	Permits / quotas	e.g. Import of pesticides/insecticides
ii. Public engagement	Public participation	Village and District Development Committees in resource conservation and management
	Information disclosure	Transparency in total environmental governance

Source: Devkota, 1999

4.3 Selected Programmes

Nepal has implemented a number of environment-friendly activities since the early 1970s, in order to minimise natural resource degradation and pollution level. Empowerment of community users in natural resources conservation, particularly forest management in the form of community forests, soil conservation and watershed management, and irrigation development and maintenance have been institutionalised and promoted through policy and legal measures.

Community forestry programmes have been expanded in almost all parts of the country. As of March 2000, about 0.650 million ha of national forests have been handed over to more than 9,000 community forestry user groups. Through this process, about 1 million local people are directly benefited.

Although, the idea of community forestry was introduced in the late 1970s, it was expanded after the enforcement of the *Forest Act, 1992*. However, despite policy interventions, legal measures, institutional development and local people's involvement, forest depletion will still occur in some areas. Based on the experiences of the community forests, HMG has also started soil conservation and watershed management activities with people's participation. The 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, mixed cropping and relay cropping in the private land and conservation plantation in the degraded hill slopes and water source protection areas.

Similar user groups concept has been expanded for the construction and maintenance of irrigation schemes, with due consideration to experiences of the Farmers Managed Irrigation Schemes (FMIS).

User groups have also been mobilised to manage the buffer zones in the Terai Parks and Reserves since the mid-1990s. This approach has been expanded to all the protected areas (8 National Parks, 4 Wildlife Reserves and 3 Conservation Areas) in a phased manner. Local user groups have been instrumental in managing Nepal's conservation areas, and utilising the natural resources for community development in a sustainable manner. This has substantially minimised the pressure of the local people on the park resources. These initiatives have also promoted ownership concept in managing the natural resources.

Indigenous management efforts are also in practice to manage local man-made resources. For example, local people have institutionalised pond rehabilitation, heritage conservation, temple renovation, etc. Such efforts have been ongoing since centuries.

HMG has also expanded the institutionalisation of environmental assessment system through policy and legal instruments. Most development projects must follow the environmental impact assessment (EIA) process legally and prepare EIA reports. This has facilitated the incorporation of environmental control measures in the project planning, design, implementation and operational stages. This EIA system has further been promoted through the implementation of the EIA guidelines which ensure public consultation and hearing. Sectoral EIA guidelines have also been prepared in order to assist the proponent to prepare sector-specific EIA report.

Several activities have been continued to generate environmental information and institutional strengthening. Equal emphasis has been given to create public awareness in order to promote environment-friendly lifestyle.

HMG has also taken a number of initiatives to minimise pollution load in the urban areas. The Ministry of Industry is pursuing environment conservation through the formulation of discharge standards of wastewater. Tolerance limits for industrial effluents discharged into surface waters are already in place. However, pollution control mainly focuses on the so-called "end-of-pipe" technologies, meaning treatment of pollution or waste at the end of an industrial process. Cleaner production technologies have also been introduced to minimise and/or avoid waste and emission, increase efficiency, reduce production costs, minimise cost of the end-of-pipe technologies, and improve product quality and working conditions. Despite these efforts, environmental pollution has not been reduced to an acceptable level and the correlation between human health and pollution is yet to be analysed in the local context.

Since 1996, HMG has been conducting the testing of vehicular emission in Kathmandu Valley. Almost all vehicles plying in the Valley have undergone the testing process and the vehicles which comply with the standards are given green sticker. Vehicular movement is prohibited in selected areas to those vehicles which do not comply with the standards.

4.4 Vehicular Pollution Control Programme

Based on the vehicle-test results and increasing pollution load, HMG banned the movement of diesel-operated three-wheelers in Kathmandu Valley, Pokhara Sub-Metropolitan City and Lumbini, the birth place of Lord Buddha, since the middle of September 1999. Similar ban has also been imposed on the registration of new two-stroke engine vehicles. However, vehicles imported or being imported under LCs opened before this decision can be registered in other areas except in the Bagmati Zone. Furthermore, two-stroke engine vehicles that comply with the Nepal Vehicle Mass Emission Standards, 2056 can be registered and operated in areas beyond the Kathmandu Valley, Pokhara Sub-Metropolitan City and Lumbini.

> With the aim of minimising the pollution load from vehicles, HMG has introduced, since 23 December 1999, Nepal Vehicle Mass Emission Standards, 2056 which are similar to EURO-1 standards (Annex 11). These standards comprise levels of Carbon Monoxide, Hydrocarbon and Oxides of Nitrogen with provisions for type approval and conformity of production of the vehicles.

Since 19 February 2000, HMG has also made necessary arrangements for prohibiting the movement of government, corporation and the diplomatic mission-owned vehicles, which do not comply with the standards prescribed from time to time, in the Kathmandu Valley. Furthermore, all 20-year-old auctioned vehicles are prohibited for registration or transfer of ownership in the Kingdom of Nepal. However, the auctioned vehicles which are below 20 years of manufacturing date may change the ownership in the country expect in the Kathmandu Valley. In addition, HMG has banned the import of reconditioned and second-hand vehicles.

All vehicles which ply in the Kathmandu Valley must have the compliance certificate. Necessary arrangements have also been made for random-checking of vehicles and petroleum products. These initiatives have contributed to improving the air quality in the Kathmandu Valley. Efforts are also under way to study the carrying capacity of roads and make necessary arrangements for controlling the registration of new vehicles in the Kathmandu Valley.

HMG is also planning to establish monitoring stations to ensure monitoring and evaluation regularly and impose environmental standards. HMG has also recently made a decision to make the Ministry of Population and Environment responsible for environmental monitoring. This new responsibility will likely contribute to develop and implement a comprehensive of Plan of Action on environmental management.

4.5 Emerging Issues

The dynamics of natural resource depletion and increasing poverty in the country is a complex scenario. It is a national challenge to conserve natural resources under high levels of poverty and rising population. A large number of the poor sustain their livelihood through utilization of the marginal resources. Consequently, over a period of time, these resources become over exploited. It is therefore, a formidable task to conserve the environment with people's participation, to alleviate poverty, and conserve and utilize resources on a sustainable basis keeping in mind the interests of all stakeholders. Following are some environmental issues likely to emerge in the near future.

4.5.1 Resource Degradation

Increase of human and livestock population will continue to exert pressure on the natural resource base, particularly the forests and land system. With the existing cultivation on steep slopes likely to continue, soil loss will be accelerated and its impact on downstream ecosystem will be tremendous. If alternative energy sources and income-generating activities are not strengthened and/or promoted, local people will continue being involved in extracting more forest products. Increased forest depletion and degradation will result in further soil loss, increase in landslides, flood frequency and water scarcity in affected areas. It is, therefore, necessary to strengthen resource management activities at the earliest possible, with due consideration of environmental concerns to attain the national goals of sustainable development and poverty alleviation.

4.5.2 Environmental Pollution

Along with socio-economic development, urbanisation coupled with industrialisation is likely to increase the utilisation of more resources and disposal of wastes. In order to improve socio-economic development, establishment of pollution-prone industries is also likely to increase. The discharge of solid wastes and untreated effluents by both domestic and industrial sources will likely increase in the coming future. Adoption of the pollution control technologies and measures may be costly and the cost of product will also increase. As a result products cannot compete in the international market, reinforcing the vicious cycle of poverty.

Urban areas may also experience changes in air quality. If vehicular and industrial emission is not regulated in time, the current practice of using the

pressure horn and emitting the gases may continue and urban dwellers will face the problem of high noise level and health cost will likely increase. In sum, environmental pollution such as air, water, sound and soil pollution will affect not only human beings, but also the terrestrial and aquatic ecosystems and their production may decline significantly. In order to minimise these problems, it is necessary to introduce the environmental quality standards.

4.5.3 Integrated Environment Management Approach

A holistic integrated environmental management (IEM) approach will arrest environmental degradation and increase national productivity. Implementation of this approach would promote ecosystem-based participatory management of natural resources and address environmental pollution through a mix of command and control (CAC) and non-regulatory market based incentive measures. A sustainable society could thus be achieved.

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Annex 1

Chronology of Natural Hazards including Earthquakes in Kathmandu Valley

Year	***Landslides and Floods***
1964	Glacial lake outburst flood along the Arun River
1968	Rockslide on 5th March and blocking of the Budhi Gandaki River A second landslip on 17th July A third landslip causing a flood of 5,210 cumecs on 1st August
1969	Floods along Gandaki river
1971	Floods along Gandaki river
1974	Rockslide and damming of Ankhu Khola at Labu Bensi and washout of Arughat bazaar
1977	Glacial lake outburst of Nare Drangka below Amadablam
1980	Glacial lake outburst and flood in Tamor
1981	Glacial lake outburst in head region of Bhotekoshi and Sunkoshi rivers Glacial lake outburst flood in Barun Khola Damming of Tinau River and downstream washout
1985	Glacial lake outburst of Dig Cho and washout of Namche hydropower station
1986	Rockslide and flash flood on Gandaki river on 30th June
1987	Flood along the Sunkoshi river and damage to the powerhouse
1988	Flood and earthquake (Eastern Nepal)
	Earthquakes
1255	King Abhaya Malla's reign (1216-1255 AD) - many houses and temples collapsed, killing one-third to one-fourth of the population in Kathmandu Valley
1681	During King Sri Nibas Malla's reign - many houses collapsed
1833	August 26, intensity X (M.M.), time 11 pm. Result: More than 100 houses leveled in a moment. Direction of motion: East-West October 4, intensity IX lasted half a minute and destruction was as bad as that of 26 August; October 18, intensity VIII
1869	July 7, intensity X: tremendous shock in Kathmandu, a large portion of the population buried in the ruins
1934	Earthquake in Nepal and Bihar; January 15, intensity X in magnitude 3,400 people died in the Kathmandu Valley alone
1963	May 23, intensity VIII. A terrible shock - destroyed a large portion of the town
1980	Earthquake in Bajhang

Source: Sharma, 1988

Annex 2

Road Washouts from Landslides and Floods

Year	Events
1979	The monsoon rains resulted in washouts of i) a 30 m span bridge across the Bijayapur Khola on the Prithvi Highway and of ii) a 60 m long bridge across the Karra Khola along with the partial washout of road sections, minor bridges and culverts on Hetauda - Birganj road leading to a rehabilitation cost of about Rs. 8 million.
1981	Twenty-seven kilometers of 114 km-long Arniko Highway was severely damaged during 1981 monsoon, mainly due to unprecedented floods along the Bhote Kosi River caused by glacial lake outburst in Tibet. The damage costs Rs. 62 million approximately.
1983 & 1984	A total of about 500 meters of road length at various sections of the Dharan-Dhankuta Highway; and 115,000 cubic meters of slip debris occurred on this road during the 1984 monsoon.
1989	Floods and an earthquake seriously affected 350 km of roads; road failures at 37 locations and damaged to 41 bridges. A total of 15 km of road and three bridges were completely washed out in the country. A 50 km length of the 114 km-long Arniko Highway was severely affected by the monsoon. Twenty-one per cent of the entire road was under risk of major failure costing to Rs. 520 to 730 million with additional maintenance costs of six to seven million rupees per year at 1990 prices for rehabilitation. Several sections of the Dharan-Dhankuta Highway damaged with about 0.5 km washout due to rains and an earthquake during the monsoon season. The damage cost approximately Rs 10 million at 1987 prices. The Charnawati area of the Lamosangu-Jiri road was affected by the washout of the Charnawati Bridge and major gullys and landslides in the three-kilometer section near Charnawati, resulting in a rehabilitation cost of Rs. 190 million from 1987 – 1991 A rehabilitation program costing Rs 91 million at 1991 prices is going on to correct the damage on the Thankot-Naubise road East-West Highway led to rehabilitation costs of Rs. 163 million at Damage to bridges, river protection, and several road sections on the 1991 prices
1991	The heavy rainfall on 1 September 1991 resulted in severe undercutting of banks of the Seti River and collapsed a 33-m span bridge over the Seti Gorge at Pokhara on the Prithvi Highway. The rehabilitation has involved the construction of a 200-m span cable, stay type bridge on the same site.
1993	Heavy rainfall and floods on 19 and 20 July 1993 caused massive damage to the Prithvi Highway, Tribhuvan Rajpath and severe damage to the East-West Highway, Phidim-Taplejung road, Bardibas-

Sindhuli Road, and Dhalkebar-Birtamod road. The total rehabilitation cost is estimated at 1,290 million Rupees at 1993 prices. Road access to Kathmandu was completely cut off for 28 days. Damage valued at (i) Rs. 200 million for the penstocks and powerhouse of Kulekhani dam, and (ii) Rs. 150 million for Bagmati Barrage.
Ten bridges damaged besides minor damage to the embankment in nine places along the East – West Highway (Pathlaiya - Dhalkebar, and Hetauda-Narayanghat section) incurring damage worth Rs. 48 million approximately
A 22 m span out of a 44 m total span of Malekhu Bridge, a 66 m span of Balkhu Bridge, and 66 m out of a 88 m span of Mahadevbesi Khola bridge washed out in Prithvi Rajmarg (Naubise – Mugling section). Further, severe road damage and failure of retaining structures occurred in 60 places. The losses were valued at Rs. 572 million approximately
3 bridges (10 m., 61 m. and 7 m. span), 23 culverts and 534m of road section in 19 places were completely washed out in Tribhuvan Rajpath (Naubise - Hetauda section). Retaining structures failed along more than 103 m of road. Further, severe damage occurred due to landslides in more than 2,090 places, road failure in 10 places for a total of over 1 Km. length, and damage to two bridges. Fifteen kilometres of road length in six sections affected.
Serious damage to a 16 km length of a road and landslides in various places resulted and damage worth of Rs. 23 million approximately in Phidim - Taplejung Highway

Source: Sharma, 1988

Annex 3

Nepal's Flora and Fauna in the CITES Appendices

Flora

Appendix I	
*Saussurea costus** (Kuth)	
Appendix II	**Appendix III**
Aloe barbadensis (Aloevera)	*Cycas pectinata* (Himalayan cycas)
Aloe sp. (Aloe)	*Gnetum montanum* (Genetum)
Ceropegia sp. (Milk weeds)	*Magnolia hodgsonii* (Magnolia)
Cyathea sp. (Tree Ferns)	*Magnolia liliiflora* (Magnolia)
Dioscorea deltoidea (Dioscorea)	*Meconopsis regia* (Himalayan Yellow Poppy)
Euphorbia sp.	
Valeriana jatamansi (Spikenard)	*Podocarpus neriifolius* (Podocarpus)
Picrorhiza scrophulariiflora (Gentian root)	*Talauma hodgsonii* (Magnolia)
Podophyllum emodi (May Apple)	*Tetracentron sinense* (Tetracentron)
Podophyllum hexandrum (May Apple)	*Rauvolfia serpentina* (Serpentine)
	Taxus baccata (Himalayan yew)

Fauna-Mammals

Appendix I	**Appendix II**
Ailurus fulgens (Red Panda)	*Cuon alpinus* (Wild Dog)
Bos gaurus (Gaur Bison)	*Equus hemionus* (Wild Ass)
Bos grunniens (Yak)	*Manis spp.* (Pangolin)
Canis lupus (Wolf)	*Primates spp.* (Monkey)
Capra falconeri (Markhor)	*Pteropus spp.* (Flying Fox)
Caprolagus hispidus (Hispid Hare)	*Fatufa spp.* (Squirrel)
***Cervus duvaucelii* (Swamp Deer)**	*Tupaia glis* (common Tree Shrew)
Elephas maximus (Elephant)	
Felis bengalensis (Leopard cat)	**Appendix III**
Felis marmorata (Marble Cat)	*Antilope cervicapra* (Black Buck)
Felis temmincki (Golden Cat)	*Arctictis binturong* (Bear Cat)
Lutra lutra (Otter)	*Bubalus bubalis* (Wild Buffalo)
Melursus ursinus (Sloth Bear)	*Canis aureus* (Jackal)
Moschus ursinus (Sloth Bear)	*Herpestes edwardsi* (Common Mongoose)
Moschus spp.(Musk Deer)	*Herpestes fuscus* (Brown Mongoose)
Naefelis nebulosa (Clouded Leopard)	*Herpestes urva* (Crab Eating Mongoose)
Ovis ammon hodgsonii (Argali)	*Marmota himalayana* (Himalayan Marmot)
Panthera tigris (Tiger)	*Martes flavigula* (Yellow-throated Marten)
Panther pardus (Common Leopard)	*Martes foina intermedia* (Stone Marten)
Panthera uncia (Snow Leopard)	*Mellivora capensis* (Haoney Badger)
Pantholops hodgsoni (Chiru)	*Mustela altaica* (Pale Weasel)
Platanista spp. (Dolphin)	*Mustela altaica* (Pale Weasel)
Presbytis entellus (Langur)	*Mustela kathiah* (Yellow-bellied Weasel)
Prionodon pardicolor (Linsang)	*Mustela sibirica* (Himalayan Weasel)
Rhinocerotidae spp. (Rhinoceros)	*Paguma larvata* (Himal Palm Civet)
Selenarctos thibetanus (Himalayan Black Bear)	*Paradosurus jerdoni* (Brown Palm Civet)
Sus salvanius (pygmy Hog)	*Tetracerus quadricornis* (Four-horned Antelope)

Ursus arctos (Brown Bear)	*Viverra zibetha* (Large Indian civet) *Viverrucula indica* (Small Indian Civet) *Vulpes bengalensis* (Indian Fox) *Vulpes montana* (Mountain Fox)

Birds

Appendix I	**Appendix II**
Aceros nipalensis (Rufous-necked Hornbill) *Aquila heliaca* (Imperial eagle) *Ardeotis nigricepas* (Great Indian Bustard) *Buceros bicornis* (Gaint Hornbill)	*Anthracoceros spp.* (Pied Hornbill) *Ciconia nigra* (Black Stork) *Falconiformes spp.* (Falcon) *Gruidae spp.* (Crane) *Ithaginis cruentus* (Blood Pheasant)
Catreus wallichii (Cheer Pheasant) *Eupodotis bentgalensis* (Bengal Florican) *Falco jugger* (Lagger Falcon) *Falco peregrinoides* (Barbary Falcon)	*Otididae spp.* (Lesser Florican) *Pitta numpha* (Indian Pitta) *Platalea leucorodia* (Eurasian Spoonbill) *Sarkidiornis melanotos* [Comb Duck (Nakta)]
Falco peregrinus (Red-capped Falcon) *Grus nigricollis* (Black-necked Crane) *Haliaeetus albicilla* (White-tailed Eagle) *Lophophorus impejanus* (Himalayan Monal) *Psittacula krameri* (Rose ringed Parakeet) *Rhodonessa caryophyllacea* (Pink-Headed Duck) *Teraogallus tibetanus* (Tibetan Snow cock) *Tragopan melanocephalus* (Western Horned Pheasant)	**Appendix III** *Anas acuta* (Northern Pintail) *Anas clypeata* (Northern Shoveler) *Anas crecca* (Common Tern) *Anas penelope* (Eurasian wigeon) *Anas qerquedula* (Garganey) *Aythya nyroca* (White-eyed Pochard) *Bubulcus ibis* (Cattel Egret) *Casmerodius albus* (Great Egret) *Columba livia* (Rock Pigeon) *Dendrocygna bicolor* (Fulvous Whistling Duck) *Egretta garzetta* (Little Egret) *Gracula religiosa* (Mynah) *Streptopelia senegalensis* (Laughing Dove) *Threskiornis aethiopicus* (Black-headed Ibis) *Tragopan satyra* (Crimson-horned Pheasant)

Reptiles

Appendix I	**Appendix II**
Crocodylus palsustris (Mugger Crocodile) *Gavialis gangeticus* (gharial) *Python molurus* (Indian Python) *Testudinidae spp.* (Land Tortoise) *Trionyx gangeticus* (Ganges Softshell)	*Elachistodon westermanni* (Indian Egg Eating Snake) *Naja naja* (Cobra) *Ophiophagus hannah* (King Cobra) *Ptyas mucosus* (Dhaman or Common Rat Snake)

Trionyx hurum (Peacock Softshell) *Varanus flavescens* (Golden Monitor Lizard)	**Appendix III** *Viperra russellii* (Russel's Viper) *Xenochrophis piscator* (Checkerd Keelback)

Amphibians
Appendix II
Rana tigerina (Indian Bull Frog)

Insects
Appendix II
Troides aeacus aeacus (Golden Birdwaing)
Troides helena subsp. serberus (Common Birdwing)

Source: Ministry of Forest and Soil Conservation

Annex 4

Plant Species Legally Protected Under the Forest Act, 1992

S.N	Scientific Name	Local Name
Ban on collection, use, sale, distribution, transportation and export		
01	*Cordyceps sinensis*	Yarsa gumba
02	*Dactylorhiza hatagira - Orchis latifolia = Orchis incarnata*	Panch Ounle
Ban on export except processed in the country and issued permission from the Department of Plant Resources		
03	*Cinnamomum glaucescens*	Sugandakokila
04	Lichens sps	
05	*Rauwolfia serpentina*	Sarpaganda
06	Silajit (rock salt)	
07	*Taxus wallichiana*	Loth salla
08	*Taxus wallichiana* or *Abies spectabilis*	Talis patra
09	*Valerina jatamansii = Nardostachys grandiflora*	Jatamansi
10	*Valerianna wallichii*	Sugandabala
Ban on transportation, export and felling		
11	*Acacia catechu*	Khayer
12	*Michelia champaca*	Champ
13	*Shorea robusta*	Sal

Source: MFSC, 1995

Annex 5

Protected Wildlife under the NPWC Act, 1973

Scientific Name	Local Name	Common Name
Mammals		
(Sus salvanius)	Sano bandel	Pigmy hog
Ailurus fulgens	Habre	Red panda
Antilope cervicapra	Krishnasar	Black buck
Bos gaurus	Gor budson	Gaur bison
Bos mutus	Yok nak	Wild yak
Bubalus bubalis	Arna	Wild water buffalo
Canis lupus	Bwanso	Grey wolf
Caprolagus hispidus	Hispid kharayo	Hispid hare
Cervus duvauceli	Barasinghe	Swamp deer
Elephas maximus	Jangali hatti	Asiatic elephant
Felis lynx	Lynx	Lynx
Hyaena hyaena	Hundar	Striped hyaena
Macaca assamensis	Asamese rato bander	Asamese monkey
Manis crassicaudata	Salak	Indian pangolin
Manis pentadactyla	Salak	Chinese pangolin
Moschus chrysogaster	Kasturi mriga	Himalayan musk deer
Neofelis nebulosa	Dwanshe chituwa	Clouded leopard
Ovis ammon	Nayan	Great Tibetan sheep
Panthera tigris	Bagh	Bengal tiger
Panthera uncia	Hiun chituwa	Snow leopard
Pantholops hodgsoni	Chiru	Tibetan antelope
Platanista gangetica	Sauns	Gangetic dolphin
Prionailurus bengalensis	Chari bagh	Leopard cat
Prionodon pardicolor	Lingsang	Spotted lingsang
Rhinoceros unicornis	Gainda	One-horned rhinoceros
Tetracerus quadricornis	Chauk	Four-horned antelope
Ursus arctos	Himali bhalu	Brown bear
Birds		
Buceros bicornis	Thulo dhanesh	Great-horned hornbill
Catreus wallichii	Cheer	Cheer pheasant
Ciconia ciconia	Seto stork	White stork
Ciconia nigra	Kalo stork	Black stork
Grus grus	Saras	Common crane
Houbaropsis bengalensis	Khar mujur	Bengal florican
Lophophorus impejanus	Danfe	Impeyan pheasant
Sypheotides indica	Sano khar mujur	Lessor florican
Tragopan satyra	Monal	Crimsom pheasant
Reptiles		
Gavialis gangeticus	Ghadial gohi	Gharial
Python molurus	Azingar	Asiatic rock python
Varanus flavescens	Sun gohoro	Golden monitor lizard

Source: National Parks and Wildlife Conservation Act, 1973

Annex 6

Yearly Energy Consumption and Percentage Share of Energy Consumption by Sector

Years	Sectors					
	Domestic	Industrial	Commercial	Transport	Agriculture	Total Energy
1984/85	204,512 (93.55)	6,070 (2.80)	1,504 (0.69)	3,890 (1.80)	295 (0.14)	216,525
1985/86	208,189 (95.58)	4,669 (2.14)	1,298 (0.60)	3,044 (1.40)	511 (0.23)	217,806
1986/87	213,346 (93.88)	5,732 (2.55)	1,285 (0.57)	3,683 (1.64)	683 (0.30)	224,866
1987/88	217,962 (93.93)	5,578 (2.43)	1,276 (0.56)	3,909 (1.70)	740 (0.32)	229,602
1988/89	223,951 (95.15)	5,399 (2.29)	1,330 (0.57)	3,797 (1.61)	714 (0.30)	235,358
1989/90	229,271 (95.68)	2,339 (0.98)	2,127 (0.89)	5,280 (2.20)	466 (0.19)	239,633
1990/91	233,872 (93.23)	5,960 (2.4)	2,541 (1.02)	4,635 (1.87)	1,009 (0.41)	248,190
1991/92	240,872 (92.14)	8,258 (3.16)	3,225 (1.23)	7,287 (2.79)	1,562 (0.60)	261,417
1992/93	247,279 (91.28)	9,226 (3.41)	3,835 (1.42)	8,669 (3.20)	1,796 (0.66)	270,915
1993/94	253,142 (91.13)	11,978 (4.31)	3,673 (1.32)	6,857 (2.47)	1,857 (0.66)	277,768
1994/95	259,456 (90.84)	12,443 (4.35)	3776 (1.31)	7,583 (2.65)	2,034 (0.71)	285,600

Source: WECS, 1996.

Annex 7

Willingness to Pay for Community Managed Waste Collection in Metro Kathmandu

Willingness to support for a community managed house to house collection system

Zone	Yes		No	
	No.	%	No.	%
Core	145	99.3	1	0.7
Middle	177	98.3	3	1.7
Outer	69	98.6	1	1.4
Total	391	98.7	5	1.3

Settler's willingness to pay for community managed waste collection service

Zone	Yes		No	
	No.	%	No.	%
Core	143	98.0	3	2.0
Middle	169	93.9	11	6.1
Outer	65	92.9	5	7.1
Total	377	95.2	19	4.8

Reasons for Un-willingness to pay for the community managed waste collection services

Zone Reason	Core		Middle		Outer	
	No.	%	No.	%	No.	%
Cannot pay fees for all types of service	2	40.0	3	60.0	-	-
Lack of capacity to pay	-	-	7	70.0	3	30.0
Unreliability of service	-	-	2	50.0	2	50.0
Public responsibility	-	-	1	100.0	-	-
Can dispose waste oneself	1	100.0	-	-	-	-

NB: N= Absolute number

Source: Thapa and Devkota, 1999

Annex 8

Vehicular Emission Test Results

(5 June 1996 to 13 May 2000)

Vehicles	Petrol *operated*	Diesel *operated*	Total	Standard *Complied*	Standard *Failed*
Government	2,907	4,187	7,094	5,258	1,836
Corporation	954	1,929	2,883	2,005	878
Private	39,616	21,373	60,989	46,768	14,221
Diplomatic	2,086	3,375	5,461	4,493	968
Service/Rent	43,550	11,414	54,964	38,297	16,667
Tourism	1,578	2,749	4,327	3,344	983
Total	**90,691**	**45,027**	**135,718**	**100,165**	**35,553**

SN	Type of Vehicle	Standard *Complied*	Standard *Failed*	Total
1	Car	51,939	12,313	64,252
2	Jeep	14,943	5,701	20,644
3	Van	11,689	4,932	16,621
4	Petrol operated Tempos	13,288	5,174	18,462
5	Diesel operated Tempos	239	1,327	1,566
6	Minibus	4,314	2,591	6,905
7	Mini-Truck	1,315	1,593	2,908
8	Bus	1,974	1,119	3,093
9	Truck	456	800	1,256
10	Crane	8	3	11
	Total	**100,165**	**35,553**	**135,718**

Source : Valley Traffic Police Office, May 2000

Annex 9

Industrial Pollution Load Scenario in Nepal

Development Region	Parameters TSP (ton)	Waste water Volume(m^3)	BOD (ton)	TSS (ton)	Solid waste (ton)
Kathmandu valley	37857	2100000	1150	1417	1421
CDR excluding valley	19950	2160000	1284	2317	8622
EDR	6626	3450000	1424	3614	9560
WDR	5505	699000	1054	1350	1615
MWDR	2610	43000	336	300	287
FWDR	3835	105000	493	593	378
Total	**76,383**	**8,556,997**	**5,741**	**9,591**	**21,883**

Source: Devkota and Neupane, 1994

Annex 10

Environmental Responsibilities of Selected Institutions

Name of the Institution	Major Environmental Responsibilities
Environment Conservation Committee, House of Representatives	Monitoring of HMG activities on environment and policy directives to the government on the environmental issues
National Planning Commission Secretariat	Integration of environmental aspects in development plan, and advice
Environment Protection Council	Policy directives and suggestions to the government and inter-agency co-ordination
Ministries	
Industry, Commerce and Supply	Technology development and transfer, standard fixation of essential goods
Law, Justice and Parliamentary Affairs	Legal advice on the ratification and accession of treaties and agreements, and membership of the international or intergovernmental bodies; Translation of treaties and agreements
Agriculture and Cooperatives	Research on agriculture chemistry and soil, development of agricultural technologies and agri-inputs, compost and chemical fertiliser, standardisation and quality control of breeds, animal and plant quarantine
Home Affairs	Traffic control, and disaster relief programmes
Population and Environment	Formulation and implementation of policy, plan and programmes, survey, study and research, focal point and co-ordination of national and international organisations, pollution control, environmental conservation and balance, monitoring and evaluation, and human resource development
Water Resources	Flood control and water resources utilisation
Land Reform and Management	Land related policy
Physical Planning and Works	Urbanisation or town development policy, plan and programmes, water supply and sewage development, settlement development
Defence	Safeguarding of national parks and wildlife reserves
Forests and Soil Conservation	Land use, utilisation, conservation and promotion of forests and forest products, natural environmental conservation and balance, soil conservation and watershed management
Science and Technology	Development of alternative energy and technology
Education and Sports	Introduction and promotion of environmental education
Labour and Transportation	Vehicle and transportation policy and management, vehicular pollution control

Name of the Institution	**Major Environmental Responsibilities**
Culture, Tourism and Civil Aviation	Conservation of cultural, touristic, archaeological and historical sites
Local Development	Local level drinking water, sewage development and sanitation, training, integrated rural development including environment-friendly technologies
Health	Environmental health and public health programmes

Annex 11

Nepal Vehicle Mass Emission Standard, 2056 (1999)

A. Vehicles Fueled with Gasoline (Positive Ignition Engines)

1 For Passenger Cars with Up To Six Seats and Gross Vehicle Weight (GVW) less than 2.5 tons

1.1 Type 1 Test - verifying exhaust emissions after a cold start

	grams per kilometer	
	Carbon monoxide (CO)	Hydrocarbons plus oxides of Nitrogen (HC + NOx)
Type Approval*	2.72	0.97
Conformity of Production**	3.16	1.13

Note: The test shall be as per the Driving Cycle adopted by different countries, with cold start on Chassis Dynamometer.

1.2 Type II Test - carbon monoxide emission at idling speed

This test applies to vehicles fueled with leaded gasoline only.
The carbon monoxide content by volume of the exhaust gases emitted with engines idling must not exceed 3.5% at the settings used for the Type I test.

1.3 Type III Test - verifying emissions of crankcase gases

The crankcase ventilation system must not permit the emission of any of the crankcase gases into the atmosphere.

1.4 Type IV Test - determination of evaporative emission

This test applies to all vehicles fueled with leaded and unleaded gasoline.
Evaporative emissions shall be less than 2 g/test.

1.5 Type V Test - durability of pollution control devices

This test applies to vehicles fueled with unleaded gasoline only.
The test represents an endurance test of 80,000 kilometer driven on the road or on a chassis dynamometer.
Not withstanding the above requirements, a manufacturer may choose to use the deterioration factors from the following table.

Deterioration Factors	
CO	HC+NOx
1.2	1.2

2 For Light-Duty Commercial Vehicles with Gross Vehicle Weight (GVW) less than or equal to 3.5 tons

2.1 Type 1 Test - verifying exhaust emissions after a cold start

Reference Mass (kg)		*grams per kilometer* Carbon monoxide (CO)	Hydrocarbons plus oxides of Nitrogen (HC + NOx)
RM < 1250	Type Approval	2.72	0.97
	Conformity of production	3.16	1.13
1250<RM<1700	Type Approval	5.17	1.4
	Conformity of production	6.0	1.6
RM>1700	Type Approval	6.9	1.7
	Conformity of Production	8.0	2.0

Note: The test shall be as per the Driving Cycle adopted by different countries, with cold start on Chassis Dynamometer.
Reference mass means the "unladen mass" (mass of the vehicle in running order without crew, passengers or load, but with the fuel tank full and the usual set of tools and spare wheel on board, when applicable) of the vehicle increased by a uniform figure of 100 kg.
Includes passenger vehicles with seating capacity more than six persons or reference mass more than 2,500 kg.

2.2 Type II Test - carbon monoxide emission at idling speed

This test applies to vehicles fueled with leaded gasoline only.
The carbon monoxide content by volume of the exhaust gases emitted with engines idling must not exceed 3.5% at the settings used for the Type I test.

2.3 Type III Test - verifying emissions of crankcase gases

The crankcase ventilation system must not permit the emission of any of the crankcase gases into the atmosphere.

2.4 Type IV Test - determination of evaporative emission

This test applies to all vehicles fueled with leaded and unleaded gasoline.
Evaporative emissions shall be less than 2 g/test.

2.5 Type V Test -durability of pollution control devices

This test applies to vehicles fueled with both leaded and unleaded gasoline.
The test represents an endurance test of 80,000 kilometer driven on the road or on a chassis dynamometer.
Not withstanding the above requirements, a manufacturer may choose to use the deterioration factors from the following table.

Deterioration Factors	
CO	HC+NOx
1.2	1.2

3 For Two Wheelers and Three Wheelers

3.1 Type I Test - verifying exhaust emissions after a cold start

	CO (grams/kilometer)		HC + NOx (grams/kilometer	
	2- Wheeler	3- Wheeler	2-Wheeler	3-Wheeler
Type Approval	2.0	4.0	2.0	2.0
Conformity of Production	2.4	4.8	2.4	2.4

Note: *The test shall be as per the Driving Cycle adopted by different countries, with cold start on Chassis Dynamometer.*

3.2 Type II Test - carbon monoxide emission at idling speed

This test applies to vehicles fueled with leaded gasoline only.
The carbon monoxide content by volume of the exhaust gases emitted with engines idling must not exceed 3.5% at the settings used for the Type I test.

3.3 Type III Test - verifying emissions of crankcase gases

The crankcase ventilation system must not permit the emission of any of the crankcase gases into the atmosphere.
Not applicable for two wheelers

3.4 Type IV Test -determination of evaporative emission

This test applies to vehicles fueled with leaded and unleaded gasoline.
Evaporative emissions shall be less than 2 g/test.
Not applicable for two wheelers

3.5 Type V Test - durability of pollution control devices

This test applies to vehicles fueled with unleaded gasoline only.
The test represents an endurance test of 80,000 kilometer driven on the road or on a chassis dynamometer.
Not withstanding the above requirements, a manufacturer may choose to use the deterioration factors from the following table.

Deterioration Factors	
CO	HC+NOx
1.2	1.2

Note: *In case of two wheelers this test is only applicable if fitted with anti-pollution devices.*

B. Vehicles Fueled with Diesel (Compression ignition engines)

1 For Passenger Cars With Up To Six Seats and Gross Vehicle Weight (GVW) less than 2.5 tons

1.1 Type 1 Test - verifying exhaust emissions after a cold start

	grams per kilometer		
	CO	HC + NOx	PM (Particulate Matter)
Type Approval	2.72	0.97	0.14
Conformity of Production	3.16	1.13	0.18

Note: The test shall be as per the Driving Cycle adopted by different countries, with cold start on Chassis Dynamometer.

1.2 Type II Test - carbon monoxide emission at idling speed

Not applicable

1.3 Type III Test - verifying emissions of crankcase gases

Not applicable

1.4 Type IV Test - determination of evaporative emission

Not applicable

1.5 Type V Test - durability of pollution control devices

The test represents an endurance test of 80,000 kilometer driven on the road or on a chassis dynamometer.

Not withstanding the above requirements, a manufacturer may choose to use the deterioration factors from the following table.

Deterioration Factors		
CO	HC+NOx	PM
1.1	1.0	1.2

2 For Light-Duty Commercial Vehicles with Gross Vehicle Weight (GVW) less than or equal to 3.5 tons

2.1 Type 1 Test - verifying exhaust emissions after a cold start

Reference Mass		***grams per kilometer***		
(kg)		CO	HC + NOx	PM
RM < 1250	Type Approval	2.72	0.97	0.14
	Conformity of production	3.16	1.13	0.18
1250<RM<1700	Type Approval	5.17	1.4	0.19
	Conformity of production	6.0	1.6	0.22
RM>1700	Type Approval	6.9	1.7	0.25
	Conformity of Production	8.0	2.0	0.29

Note: The test shall be as per the Driving Cycle adopted by different countries, with cold start on Chassis Dynamometer.

Reference mass means the "unladen mass" (mass of the vehicle in running order without crew, passengers or load, but with the fuel tank full and the usual set of tools and spare wheel on board, when applicable) of the vehicle increased by a uniform figure of 100 kg.

Includes passenger vehicles with seating capacity more than six persons or reference mass more than 2500 kg.

2.2 Type II Test - carbon monoxide emission at idling speed
Not applicable

2.3 Type III Test - verifying emissions of crankcase gases
Not applicable ✍

2.4 Type IV Test - determination of evaporative emission
Not applicable

2.5 Type V Test - durability of pollution control devices
The test represents an endurance test of 80,000 kilometer driven on the road or on a chassis dynamometer.
Not withstanding the above requirements, a manufacturer may choose to use the deterioration factors from the following table. ✍

Deterioration Factors		
CO	HC+NOx	PM
1.1	1.0	1.2

3 For Heavy-Duty Vehicles and Vehicles with Gross Vehicle Weight (GVW) more than 3.5 tons

3.1 Type I Test - verifying exhaust emissions after a cold start

Pollutants	**Type Approval**	**Conformity of Production**
CO (grams per kilo-watt hour)	4.5	4.9
HC (grams per kilo-watt hour)	1.10	1.23
NOx (grams per kilo-watt hour)	8.0	9.0
PM (grams per kilo-watt hour) for engines with power less than 85 KW	0.61	0.68
PM (grams per kilo-watt hour) for engines with power more than 85 KW	0.36	0.40

Note*: The test shall be as per the Test Driving Cycle adopted by different countries with 13 Mode Emissions Engines Dynamometer Test.*

3.2 Type II Test - carbon monoxide emission at idling speed
Not applicable

3.3 Type III Test - verifying emissions of crankcase gases
Not applicable ✍

3.4 Type IV Test - determination of evaporative emission
Not applicable

3.5 Type V Test - durability of pollution control devices
Not applicable ✍

Note :
* Please see the explanatory note
** Please see the explanatory note
✍ As amended by the decision of HMG/N of 2056.12.02
✍ As added by the decision of the HMG/N of 2056.12.02

Explanatory Notes

1. **Type Approval**: Most countries require some form of certification or type approval by vehicle manufacturer to demonstrate that each new vehicle sold is capable of meeting applicable emission standards. Usually, type approval requires emission testing of prototype vehicles representative of planned production vehicles. Under ECE and Japanese regulations, such compliance is required only for new vehicles. U.S regulations require that vehicles comply with emission standards throughout their useful lives when maintained according to the manufacturing specifications.

   The advantage of a certification or type approval program is that it can influence vehicle design prior to mass production. It is more cost effective because the manufacturers identify and correct the problems before production actually begins.

2. **Approval of a Vehicle**: Vehicle manufacturers apply for approval of a vehicle type with regard to exhaust emissions, evaporative emissions and durability of pollution control devices to the authority responsible for conducting the tests. The application for approval also includes details like description of engine type comprising all the particulars, drawings of the combustion chamber and of the piston, description of evaporative control system, particulars concerning the vehicles, descriptions of pollution control devices etc. If the vehicle type submitted for approval meets the requirements of various types of tests mentioned, only then the approval of that vehicle is granted.

3. **Conformity of Production**: The conformity of production is an assembly line testing system. The objectives of assembly line testing are to enable regulatory authorities to identify certified production vehicles that do not comply with applicable emission standards, to take remedial actions (such as revoking certification and recalling vehicles) to correct the problem, and to discourage the manufacture of non-complying vehicles. This test provides an additional check on mass-produced vehicles to assure that the designs found adequate in certification are satisfactorily translated into production, and that quality control on the assembly line is sufficient to provide reasonable assurance that vehicles in use meet standards. The basic difference between TA and COP is that TA is based on prototype vehicle or design of the vehicle while COP measures emissions from real production vehicles.

   As per the requirements set forth by the European Union, a sufficient number of random checks are made of serially-manufactured vehicles bearing the type approval mark of vehicles bearing all the types of tests mentioned above. The tolerance limits are provided for conformity of production in Type I test.