

THE NATIONAL STATE OF THE ENVIRONMENT REPORT

NEPAL

SC-SACEP/SOE 95/NEPAL

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Preface

The need of preparing 'The National State of the Environment Report' for Nepal towards working out 'State of the Environment Report for South Asia 1995' has been noted as contained in the letter dated January 13, 1994 from SACEP addressed to the Member-secretary, Environment Protection Council, Kathmandu. Within the given limitation of a month's time ending July 1994, it has not been possible to do essential justice in processing the material under Part-I and Part II; there may therefore, be omissions and lack of oriented presentations; furthermore, it has not been possible to adhere to the length in maximum prescribed. It may be stated herein that Chapter 4 outlined for Coastal and Marine Environment being not applicable for Nepal, remains omitted.

Nepal being the landlocked mountainous country the fragility of natural resources, interdependence with the eco-provinces around, and requirement of using natural potentialities effectively for economic development, have been often in references at the policy formulations and decision making levels. The need of regional get-together both for national achievement and in building cohesiveness amongst the neighbouring nations of South Asia have been well-pronounced by Nepal; and, efforts in that direction have been maintained to date. The concept of sustainability encased in the 'Caring for the Earth', *National Conservation Strategy* for Nepal under implementation, and expressive seriousness towards assimilating *Rio Declaration* are the major thrusts in guiding policy enunciations, institutional adaptations and towards considering environmental issues to be interwoven with developmental programmes framed up for implementation. There is a pronounced difference between agreeing theoretically and practical implementation—this being essentially true and applicable everywhere. However, given that Nepal aspires its national growth in the framework of regional development there is a deep-seated commitment in Nepal to offer its undeviated collaboration and faithful adherence to the development of the region.

Based on these emerging realities orienting the decisions, formulations and commitments in Nepal today, the contents of Part-III and Part-IV of this report are built up. There is not much in special to be elaborated as far the *environmental technology* is concerned; however, the cultural history leading to emergence of Caravan trading in the highland, terrace development in the midland hills, and resorting to the rice cultivation in the lowlands have been traced; and, programme undertakings related to the watershed management imbibing the concept of resource conservation and sustainability through the mechanism of peoples' participation and mobilisation of built up institution to function at the local levels, have been referred to as the environmental exercises in various stages of technological implementation.

I cherish the opportunity provided by the EPC for taking up this exercise and do hope that the text shall be meaningful to some extent towards developing state of Environment Report of South Asia as well as for ESCAP state of the Environment Report.

I remain indebted to IUCN Office for accommodation, transport and secretarial support while working out this report.

Kathmandu
Thursday : August 4, 1994

Chiranjeevi L. Shrestha (Vaidya)

Executive Summary

I. Environmental Conditions and Trends

Land

Nepal is located at the mid-segment of the Himalayas. It is made up of 43 per cent mountains, 43 per cent hills (including Siwalik), and 14 per cent terai flat plain. So the land is marginal. The hilly terrain had been the seat of population concentration; and after the intervention of technology to eradicate malaria in 1950s the major shift of population started from the hill to the terai.

Watershed condition in the mountain is excellent to good and in the hills good to fair/poor; and as per record 18,000 km² of land (12 per cent of the area) is in poor condition and is deteriorating at an unknown rate.

Degraded land systems have been identified in the mountain (High Himalaya and High Mountain) and in the hills (Middle Mountain and Siwalik). The land capability indicates 32 per cent of the land is good for agriculture, 31 per cent is suitable for forest and pasture and the remaining 37 per cent is unstable and ecologically fragile.

The land system made up of alluvial plains, ancient lake deposits and river terraces are of agricultural importance and the high land area with coverages of alluvium and morainal deposits support monsoon grazing.

Forest and Wildlife

As per distinct climatic variation three vegetational zones (i) Tropical/Sub-tropical, (ii) Temperate, and (iii) Sub Alpine/Alpine Zones, have been recorded. The forest land is 5.5 million ha; and its distribution is almost equal in the three belts (i) Mountain, (ii) Midland hill, and, (iii) Siwalik (including terai having 8 per cent forest).

Change in forest land is quite notable both in terai and hilly region during 1973-85. The forest density worked out in 1986 indicates very high percentage of degraded forest in the hills. The plantation rate is less compared to deforestation rate; and there is acute shortage of fuelwood and fodder.

Out of the 35 forest types 25 are confined to mountain park and reserves. The protected areas in total are around 10.8 per cent of the country. It is well represented in the mountain 80.5 per cent, recordable in the terai 17.2 per cent, and very poor being 2.3 per cent only in the hill. Amongst the protected wildlife listed there are 26 types of mammals, 9 species of birds and 3 types of reptiles.

Inland Water

The inland water area is around 745 thousand hectares made up of natural waters (rivers/lakes) 54 per cent, irrigated rice fields and marginal swamps 45 per cent, and village ponds 1 per cent. In the high cold mountain very few fauna and flora are noticed; the biota of the midlands are diverse; and in the tropical rivers and lakes there are different types of fishes. Commercially valued species cultured are

seven : three indigenous and four exotic species; and around 12,000 families have been estimated to have been engaged in this occupation. Massive deforestation, high level of siltation and pollution are damaging the breeding areas of indigenous fish species.

Atmosphere and Climate

The climate is controlled by monsoonal wind and latitudinal variation: summer monsoon makes a coverage of 85 per cent and the remaining is supplemented by winter rain. The rainfall in average varies from 250 mm (dry region) to 4,500 mm in humid region and temperature range is quite wide following diverse topography: in the tropic 30°C (in summer) and 15°C in winter to Arctic frost below 0°C through the year.

Climatic divisions worked out are:

- (i) Sub-tropical monsoon: terai and inner valley.
- (ii) Temperate monsoon: central belt with warm wet summer and cool dry winter.
- (iii) Alpine belt 4000-8000 m: cool short summer and cold winters.
- (iv) Tibetan belt: cool summer and temperature difference pronounced between sun and shade, and between day and night.

The level of freezing varies annually from 3,000 to 6,000 m and the snow melt contribution to the river flow is highest before the onset of monsoon exceeding 30 per cent of overall monthly average discharge. The role of monsoon is dominant compared to the role of snow.

Indoor air pollution much more concentrated due to poor ventilation, has been recorded in the high altitude villages. Out door pollution from automobile and cement factories are quite notable in Kathmandu.

Wastes, Toxic and Hazardous Chemicals

Around 40 per cent of the solid wastes generated is collected and 60 per cent is dumped in general. The composition of solid waste at the Vishnumati river in Kathmandu reveals : (i) soil/stones 72 per cent, (ii) bones 15 per cent, (iii) clothes/paper cardboard 9 per cent, (iv) plastics 2.5 per cent, and (v) glass/metals 1.5 per cent. Few of the industries observe disposal of solid waste; hospitals generate hazardous and infectious wastes; and industrial processes are potential sources of toxic gases, heavy metals and carcinogenetic compounds. High concentration of lead is received from combustion of petrol. Many of the insecticides, herbicides and fungicides used in Nepal are toxic and persist in the food chain.

Natural Disasters

The mountainous country is prone to natural disasters. These are built up by (i) tectonic forces in manifestation, (ii) geologic formations and topography, (iii) nature of monsoon and climatic changes, and by (iv) human behaviour regarding land use. The terai rivers are unpredictable during the monsoon; Himalayan rivers transport more material from high gradient slopes; and Glacial Lake Outburst Flood (GLOF) has been occurring more than once every three years. Flood damage of 1987 and 1988 have been devastating in terms of property destroyed. Flood and drought can occur in the same year and in the same location; and water surplus area can suffer from severe water scarcities. It has been noted that 30 per cent of the landslides occur in the Himalayas. In the central and western developmental regions of Nepal 78 major landslides occurred annually during 1970-80 with an average annual loss of Rs. 6.5 million.

The record suggests that there were 23 major earthquakes in Nepal during 1800-1975; whereas in the last 55 yrs there were 3 major earthquakes; 1935 Bihar/Nepal earthquake destroyed 3400 lives, 1980 Bajhang earthquake struck heavy loss of life and property; and 1988 Udaipur earthquake deemed to be of moderate category have been devastating, damaging 63,000 houses and injuring over 6000 people.

II. Causes and Consequences

Poverty and the Environment

Agriculture is the major source of income and poor productivity is contributive to poverty. Around 50 per cent of the farmers own land less than 0.5 ha. in size; and average land holding is 0.15 ha. Landless farmers have risen to 20 per cent by 1981/82 and 16 per cent farmers own 63 per cent of the land under cultivation. The population increase is 2.6 per cent and food productivity is falling by 0.5 per cent annually. Per capita production was 92 per cent of requirement (in 1976) and it came down to 80 - 85 per cent of requirement in 1988; and 40 - 60 per cent of population live at levels below minimum calorie intakes. Income of the bottom 40 per cent and top 10 per cent of the people are equal having 23 per cent of the income in each case, and the middle 50 per cent have the remaining 54 per cent of the income. It is estimated that 49 per cent of the population is below the poverty line; 97 per cent of them live in rural areas mostly in hills and mountain and a few in terai.

Soil loss from terraces, decline in soil fertility, degradation of forest and overgrazed pastures are the common features. Agricultural land is limited : 5 per cent of the hills is considered good for agriculture, 38 per cent require terracing and the remaining is suitable merely for forestry; furthermore the agricultural holdings are small and fragmented; and out-migration is in response to the inability of the hill farmer households to feed themselves. The forest and grassland are poorly managed and natural resource based tourism adds to the pressure of fuelwood.

Population and Lifestyle

Around 94 per cent of the hill districts are over-populated. In around three decade's duration the population is getting doubled as seen in 1952/81, 1961/91 and as projected in 1981/2010. Four million girls approach reproductive age : and, this figure is 50 per cent higher than all women currently fertile; as such this generation, will have no impact on population control measures adopted. Typical household produces only two-third amount of food required and the hills are chronic food deficit areas; and in view of shortage of land and lack of employment opportunities out-migration is the only choice : north to south, and highland to lowland as well as to the urban areas. Population growth has become severe in building up negative effect on food balance : as projected, food deficit in 1995 is of a magnitude of 0.5 million M/T affecting 2.6 million people – 12 per cent of the total population, and by 2010 it affects 6.2 million people – 20 per cent of the total population. And this deficit is accentuated by the growing unemployment and under-employment.

The state of unemployment is notable : (i) 65 per cent of the household labour days are under-utilised, and (ii) off-farm work activity accounts to 15 per cent household working days. Due to lack of manufacturing industry for employment the hill population depends on infrastructure and reafforestation activities. It has been estimated that during 1990-2000 labour force is to grow by 2.7 per cent per annum and by 2010 around 290,000 people will be entering labour market annually.

Urbanisation

Urban centre was defined in 1961; the number rose from 10 (in 1952/54) to 23 in 1981 and to 33 in number in 1987; the distribution of these settlements is 8 in hills, 3 in Kathmandu, 4 in inner terai and 18 in the terai.

Kathmandu, Birgunj and Biratnagar formed a location triangle encompassing major industrial enterprise; and in 1981 out of 64 medium and large scale industries 52 were concentrated within the triangle zone. Average urban growth rate during 1981-91 was 5 per cent annually; there was decline in growth rate in some of the terai and inner terai urban centres while comparing between the two decades 1971-81 and 1981-91; whereas Pokhara, Bharatpur and Kathmandu have been singled out as the three fastest growing towns of Nepal.

Data of the past three decades (1961-1991) shows that the proportion of population living in urban areas increase with the size of the urban centre. Secondary gateway towns along the foothill as well show growth rates in excess of 4 per cent in the eighties. Emerging trends indicate that Kathmandu valley, Terai and Inner Terai region and Pokhara (among the hill town) will experience urban development in the near future. Urban population of Nepal has been projected to 3.2 million in 2002 and 7 million by 2010.

Agriculture and Fisheries

Basic data on production and yields for the duration 1972-86 shows decline in the yields of all crops : the reasons advanced being (i) marginal land brought into cultivation, (ii) decline in quality of compost, (iii) loss of soil fertility through erosion, and (iv) paucity of irrigation.

Farmers have been categorised in three groups as per size of the land holdings. Farmers having land below 0.5 ha. are subsistence oriented and so forced to take off-farm work, seasonal migration and resort to intensive cropping. The farmers holding land in the range of 0.51-1.0 ha are likely to be cereal deficit households and are vulnerable to the vagaries of the weather; and off-farm income is needed to supplement their food supply. Farms 1.01 ha or larger are self-sufficient towards producing enough cereals for their needs. But it has been observed that compost application on larger farms are very low. The areas under some form of irrigation facilities were estimated; and out of the total facilities 72 per cent is contributed by the farmers.

Fish production activities are taking place in 60 districts out of the 75; and integrated fishery development programme are operating in 21 districts. Aqua-culture development shows potentiality for expansion. Production trends for warm water fisheries indicate the attainment of sustainable development.

Industry

The average growth rate of the industrial units from 1976/77 to 1986/87 was 15 per cent and the employment also rose in the same magnitude. The number of establishment in 1986/87 was recorded as 9359 out of which manufacturing units figure out to be 3633 employing over 137,000 people. Industries with foreign collaboration figure out to be 117 units with capital investment amounting to Rs. 5,418.6 millions in 1991. Establishments located in urban areas are 3112; and 78 per cent of these are manufacturing units. Analysis of 1589 manufacturing industries located in 11 municipal areas indicate : (i) 48 per cent are located in Kathmandu valley, (ii) 6 per cent in the hilly region, and (iii)

46 per cent in the terai and inner terai; furthermore 68 per cent of those are located in the triangular zone within Kathmandu, Birgunj and Biratnagar.

More than 80 per cent of the industrial activity is understood to be concentrated in four major zones : (i) Kathmandu valley, (ii) Biratnagar - Itahari, (iii) Birgunj - Hetauda, and (iv) Butwal - Siddhartha Nagar. Industrial growth and expansion have followed merely infrastructure facilities without any consideration of land use. It is growing haphazardly along the major north-south roads leading to East-West highways. The IUCN (1990) survey records that 84 per cent of the industries are having problems of air pollution; and 50 per cent of these units have not adopted pollution control measures. NECG's survey of point source pollution indicates that 64 per cent of urban based manufacturing establishments are pollution prone. EMA Group (1991) survey confirms that industrial effluents contain various types of heavy metals (including toxic elements) and non fecal and fecal coliform bacteria.

Energy

Due to paucity in exploitation of its potential hydropower there is as yet major reliance on traditional fuelwood and the use of commercial energy (petrol, coal, electricity) remains to be known as the urban fuel. Forest being the major energy source plantation programme is on active list and barren land is being identified for reafforestation scheme. Agricultural waste and animal dung are additionally important biogenetic sources for energy.

Installed hydropower capacity by (1990) was merely 238 MW and by 2000 it is expected to rise to 654 MW, 1.6 per cent of the economically feasible potential. Consumption of generated electrical energy in various sector (including 44 per cent in domestic sector) in 1985 is notable. There has been considerable increase (153 per cent) in the consumption of fossil fuel in the period between 1960 and 1985; and increase in demand of kerosene between 1982 and 1983/84 has risen by 81 per cent.

The possibility of raising solar energy and evidence of abundant wind energy are the potential avenues requiring both judicious investment and effortful exercises. In other words realistic development of alternative energy could meet enormous needs of energy in totality at large.

Transport

Physiographically the distribution of road in the terai is high, in the hill it is significant and in the mountain it remains negligible. Following 1989-90 road mileage the distribution under the categories of Highway, District road and interconnecting roads are almost equally balanced and the figure of urban road is significant.

In view of regional development the north-south and east-west oriented road linkages, district/village level transport, development project related roads and essential provision of maintenance as well as stabilisation are quite important; and this pattern of programme formulation has been followed in the Eighth Plan. Progress of programme implementation related to ropeway, railways, trolley bus and internal water route may need to be effortfully reviewed and revised in the course of implementation utilising maximum hydropower which may be possibly availed in a given time and location.

Tourism

Touristic statistics (1987) records 6.7 per cent annual growth rate during the past decade and foreign exchange earning of Rs. 1.088 billion, 26 per cent of all earnings. The figure of tourist inflow has risen

from 163 to 248 thousand during the decade 1980/90. Mid-altitude trekking and wildlife tourism visiting natural resource related areas are notable in terms of number of tourists. The religious tourists visit traditional sites. Economic contribution of natural resource tourism (1987) is around US \$ 4.8 million out of which 11 per cent is the revenue earning to the government. The National Parks were visited by over 37,000 people in 1987 specially the Chitwan National Park; and the revenue earned comes up to US \$ 3.96 million. The impacts on the resource base are : (i) Increased fuelwood demand affecting watershed and vulnerable areas, (ii) ecological consequences of consistent overuse on aquatic life, flora and fauna, and (iii) environment pollution. Management philosophy practiced by ACAP is yet to be extensively exercised. Specific points required to be considered are : (1) Introduce fuel sufficiency rule for all the protected areas; (2) work out managerial plans for natural areas which generate economic incentives to local people; (3) create incentives for investment; (4) levy a new environmental tax for park management; and (5) reorganisation of management and monitoring under one organisation.

Human Health and Environment

Cereal balance by household (1977/78) indicates that all farmers are deficient in relation to expressed requirements. The most disadvantaged groups are small farmers and only or mainly bari farmers. They produce 25 to 38 per cent of their requirements and this severity is accentuated by growing unemployment and under-employment. Protein deficiency is a general problem and chronic malnutrition affects 80 per cent of the children.

Standard of health indicators have improved due to immunisation campaign, malaria eradication, family planning and health facilities provided in urban areas. Maternity death rate is high in rural areas and around 77,000 people (2.1 per cent of the economically active population) are estimated to be disabled.

There is express relationship between chronic bronchitis and habit of smoking as found in Kathmandu and Jumla. Water borne disease affect 80 per cent of the population at any given time; and there is high mortality rate due to gastro-enteritis, diarrhea and other communicable disease. Incidence of iodine deficiency is high; 70 per cent of the villages in some areas are affected by goitre with cretinism.

Sedimentation and flood hazards, industrial pollution and dumping of solid wastes have affected quality of air and drinking water. Most industries located close to water bodies discharge toxic effluents without treatment. Quality of drinking water in major urban centres has been found poor; water samples of Kathmandu, Pokhara and Biratnagar contain contamination of fecal and fecal coliform bacteria; and even the ground water of Kathmandu has been found contaminated. Il-ventilated housing system without chimney is often the cause of chronic bronchitis. The trend of air pollution is on increase in Kathmandu urban area and there is high level of lead content and other particulates.

III. Response

Environmental Technology

Tibetan civilisation in the Himalayan plateau, traditional tribal culture in the rugged precipitous mountain and Hindu civilisation in the lowland, developed the pattern of resource management in the ages past. The clustered settlement as the core with provisions of upland field, grassland and natural forest evolving agro-pastoralism *cum* forest preservation are the basis of tribal resource management.

Beautiful terraces carved out in the hilly terrain are the testimony of the environmental technology developed through the ages. The coincidence between the available amount of warmth and a profitable kind of crop rotation in each altitude indicates that maximum amount of harvest was always aimed at. Crop rotation is the system to respond to the carrying capacity of the land in reference; and rotational pasture came up as the pattern of resource management for facilitating sustainable growth and maximum use of the nourishing meadows. Enrichening the land with dung and urine of depastured animals after the harvest, and raising butter and cheese at the same time are the technic of maximising productivity. As recorded by (Kawakita 1984) in the Nepalese midland, population pressure leads to weakening of community solidarity, decrease in income and deterioration of quality of life resulting inferiority complex and outflow of talent. Watershed management programmes have been undertaken in all the eco-belts in the midland hills. Agro-forestry has gained popularity in meeting human needs in economic terms. Watershed programmes at the district levels are supportive to the protected areas by resorting to rehabilitation of degraded terrain. Extension programme is promoting conservation with expressive objective of upgrading quality of life and enlarging management capabilities. The concept of users' group has grown popular and is progressively getting established in making profitable use of, and management of resources.

Environmental Management : Policies Institutions and Monitoring Mechanisms

Environmental elements were sectorally pursued in the course of seeking economic return during the First Four Plans; watershed development emerged as the major developmental theme in the Fifth Plan and the concept of ecological balance was advanced in the Sixth Plan. During the Seventh Plan environment was underlined as the concern for National Development; and major formulations such as National Conservation Strategy for Nepal, Master Plan for the Forestry Sector and EIA Guidelines for major sectors were the notable exercises.

In the Eighth Plan enunciation and formulations, environmental elements are internalised as essential constituent in relevant sectors and environment has been identified as a major separate sector. Nepal Environmental Policy and Action Plan has worked out policy areas and relevant programme with reference to the implementing institutions towards developing correlative exercises between policy, programme and implementational practices.

The Environment Protection Council and its secretariat developing focal points with relevant ministries await endorsement by the Parliament for the authoritative power it requires to exercise. The importance of monitoring and evaluation has been often talked about; there is the provision of Central Monitoring and Evaluation Division; as such mechanism in practice are to be followed to achieve the objectives it seeks for.

Communication for the Environment : Education and Awareness

The extension programme focusing on resource management, has essentially the leverage of two way communications towards raising level of awareness promoting newly acquired knowledge, and to encourage increased participation in land use practices and conservation farming. Various departments exercised this programme to gain their respective sectoral objectives and the users' groups have emerged for maximising appropriate use of resources, regulating organised setting, as well as for managerial undertakings of the resources. There are various avenues developed for environmental communication; and consultative get-together with experts, policy makers, politicians and social workers are bearing effective reciprocation towards building up opinions and receiving valuable interactions. Following the NCS Implementation Project, NGOs have been quite active in Environmental Management Programme in varied geographical belt to orient the thoughts of the rural

community in protected areas, municipality as well as in considering urbanisation issues. ECCA Camps have become quite popular; activities of conservation groups are held with good esteem; and womens' groups/organisations are getting progressively active with emerging leadership. The programme of "Street Theatre" seeks to revive the traditional practice of activating effective means of revolutionising the ideas of the people for essential adaptations, and encourages various organisations to make respective inputs.

The newsletters coming out have become effective in propagating the knowledge of investigational activities going on in the environmental sphere. In some way it has become catalytic media in building up advanced opinions at various levels and sectors.

Regional, Sub-regional and Global Responses

Stockholm Conference and series of UNESCO sponsored expert consultations, and Regional Meetings influenced conservation oriented formulations and practices of Nepal. The offer of regional cooperation in utilising potential water resources of the Himalayas for the benefit of the region was forwarded in 1977; expressive consultation meetings related to the formation of SACEP were attended with faithful will; and thereafter, pursuance to establish ecological centre for the South Asian Mountain System was effortfully made resulting inauguration of ICIMOD in Kathmandu in 1983.

Endorsement of the documents on National Conservation Strategy and Master Plan for Forestry Sector reflected the level of Nepalese seriousness and firm commitment towards resource management; and, SAARC (1985) with Head Quarter in Kathmandu created a platform for pursuing regional consultations and undertakings effortfully.

Concern on the risk of Glacial Lake Outburst, sustainable use of water in Nepal for power, irrigation and transport as well as ecological and economic consideration for the Gangetic provinces necessitate adoption of regional insight in the management of the major rivers. Regional conservation strategy may facilitate bilateral network arrangement for protecting wildlife and promote genetic diversity. Ecological provinces being interdependent national development may be achieved with regional outlook; as such, the recognition of macro-ecoprovince is to be carefully built up towards addressing environmental issues and resource management undertakings.

Experiences do indicate that over dependence on government machinery may not be effective and productive; and the private sector may be encouraged cautiously to shoulder responsibilities and utilise pockets of small savings under enunciated policies and periodic guidelines.

IV Challenges and Opportunities

Follow up of Agenda 21. Challenges to Sustainable Development : Concept, Policies and Issues with Regional and Sub-regional Focus

Nepalese aspirations have been to avail basic needs, harness resources in a sustainable manner and resort to industrialisation with ecological consideration; and the principles of Rio Declaration adhering to Human being as the centre of concern and emphasizing the role of indigenous people are both referable and supportive to the developmental problems and managerial issues.

The policy orientation, decision making capabilities, and promotion of biodiversity and biotechnology categorised under socio-economic and conservation/ management dimension are the major

enumerations for accomplishment. Exercises to upgrade concern of the indigenous people, institutional arrangement, implementation technique and sorting out of traditional information for decision making procedures are the major dimensions yet to be built up.

The background policies and programmes in general are built up and strong political will needs to be exercised during the active phases of implementation, and promotion of regional cooperation to ascertain faithful accomplishments of what has been committed at various levels.

Prospect for the 21st Century : A Regional Perspective

Social, cultural and economic dimensions developed with the nature of resource management; in these exercises geographical, ecological and considerative reciprocations to a broader horizon for a period to come, were always the strategic steps referred to. All these may be set for our understanding today as regional cooperation for the balanced development of macro-ecoprovinces of South Asia. The theme of thinking globally and acting locally does lead us to understand its in-depth significance for ensuring national developments to which we are committed. In an effort of describing the orbit of our concern an institutional network for working relationship in way to resolve issues, is to be kept in active agenda for regulated operation.

The highland encompassed by the Himalaya and other sister ranges, is the seat of Nature's laboratory about which our knowledge remains limited. An integrated centre of researches might be beneficial to the region as a whole in developing understanding of physical, meteorological, biological and tectonic activities set in perpetual process for working out balanced adaptabilities. This would be richly supportive to build up national excellence in the framework of the regional potentialities, maximise use of the regional talent, and consolidate region's opinion with cooperative altitude for the global cause.

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Abbreviations and Acronyms

ACAP	Annapurna Conservation Area Project
ADB	Asian Development Bank, Manila
APROSC	Agricultural Project Services Centre, Kathmandu
ARTEP	Asian Regional Team for Employment Promotion
ATCHA	Association for Technical Cooperation to the Himalayan Areas, Tokyo
BHC	An Insecticide : <i>Benzene Hexa Chloride</i>
BOD	Biodegradable Oxygen Demand
CBS	Central Bureau of Statistics, Nepal
CCNCR	Council for Conservation of Natural and Cultural Resources
CDR	Crude Death Rate
CEDA	Centre for Economic Development Administration, Nepal
CFC	Chlorofluorocarbons
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CP	Crude Protein
DDT	<i>Dichloro Diphenyl Trichloro-ethane</i>
DFAMS	Department of Food and Agricultural Marketing Services (Ministry of Agriculture), Nepal
DNPWC	Department of National Parks and Wildlife Conservation, Nepal
DSCWM	Department of Soil Conservation and Watershed Management
ECCA	Environmental Camps for Conservation Awareness
EIA	Environmental Impact Assessment
EMAG	Environmental Management Action Group
EPC	Environment Protection Council
EPCS	Environment Protection Council Secretariat
EPD	Environment Protection Division, National Planning Commission
ERL	Environmental Resources Limited, London
ESCAP	Economic and Social Commission for Asia and Pacific
FAO	Food and Agriculture Organization, United Nations
FDD	Fisheries Development Division
FES	Friedrich Ebert Stiftung
GDP	Gross Domestic Product
GEF	Global Environment Facility

GLOF	Glacial Lake Outburst Floods
GNP	Gross National Product
GWH	Gigawatt per Hour
Ha.	Hectare
HMG	His Majesty's Government of Nepal
ICIMOD	International Centre for Integrated Mountain Development, Nepal
ICS	Improved Cooking Stove
IDS	Integrated Development Systems, Kathmandu
IMR	Infant Mortality Rate
IRDP	Integrated Rural Development Project
ISC	Industrial Service Centre
IUCN	International Union for Conservation of Nature and Natural Resources (The World Conservation Union)
KHARDEP	Koshi Hills Area Rural Development Programme
KMTNC	King Mahendra Trust for Nature Conservation, Nepal
KW	Kilowatt
KWH	Kilowatt per Hour
LRMP	Land Resources Mapping Project
LU/LSU	Livestock Unit
MAB	Man and the Biosphere Programme
MBF	Main Boundary Fault
MCT	Main Central Thrust
MPFS	Master Plan for the Forestry Sector, Nepal.
MSUD	Management Support for Urban Development
MT	Metric Ton
MW	Mega Watts
NARC	National Agricultural Research Council
NCCNCR	National Council for the Conservation of National and Cultural Resources
NCCNR	National Commission for the Conservation of Natural Resources
NCS	National Conservation Strategy for Nepal
NEA	Nepal Electricity Authority
NECG	Nepal Environmental Conservation Group
NEFAS	Nepal Foundation for Advanced Studies
NEFEJ	Nepal Forum of Environmental Journalists
NEHI	Nepal Environmental Health Initiative
NEMP	NGO Environment Management Programme
NEPAP	Nepal Environmental Policy and Action Plan

NESS	Nepal Environment and Scientific Services
NGO	Non Governmental Organization
NIDC	Nepal Industrial Development Corporation
NOC	Nepal Oil Corporation
NP	National Park
NPC	National Planning Commission, Nepal
NSIC	Nepal Standard Industrial Classification
NTMP	Nepal Tourism Master Plan
PAN	<i>Peroxyacetyl nitrate</i>
PCRW	Production Credit for Rural Women
PPI	Population Pressure Index
RCUP	Resource Conservation and Utilization Project, Nepal
RECAST	Research Centre for Applied Science and Technology
RNAC	Royal Nepal Airlines Corporation
RONAST	Royal Nepal Academy for Science and Technology
SAARC	South Asian Association for Regional Co-operation
SACEP	South Asian Cooperative Environmental Programme
SFDP	Small Farmers Development Project (ADB/Nepal)
SGP	Small Grants Programme
SQ KM	Square Kilometre
SWMRMC	Solid Waste Management Resource Mobilization Centre, Nepal
TCE	Ton Coal Equivalent
TDN	Total Digestible Nutrient
TPD	Tourism Promotion Board
UN	United Nations
UNCED	United Nations Conference for Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational Scientific and Cultural Organization
UNFPA	United Nations Fund for Population Administration
WCED	The World Commission on Environment and Development
WECS	Water and Energy Commission Secretariat, Nepal
WHO	World Health Organization, United Nations
WRI	World Resources Institute
WWF	World Wildlife Fund

Part

Environmental Condition and Trends

CHAPTER 1

Land

Physiography

Nepal (26°22'N to 30°27'N latitude, 80°04'E to 88°20'E longitude) constitutes a part of the central segment of the Himalayan Mountain System. It extends 800 km east-west along the Central Himalayas with an approximate width of 120 km and covers an area of 147,181 sq. km.

Table 1
Physiographic belt in succession

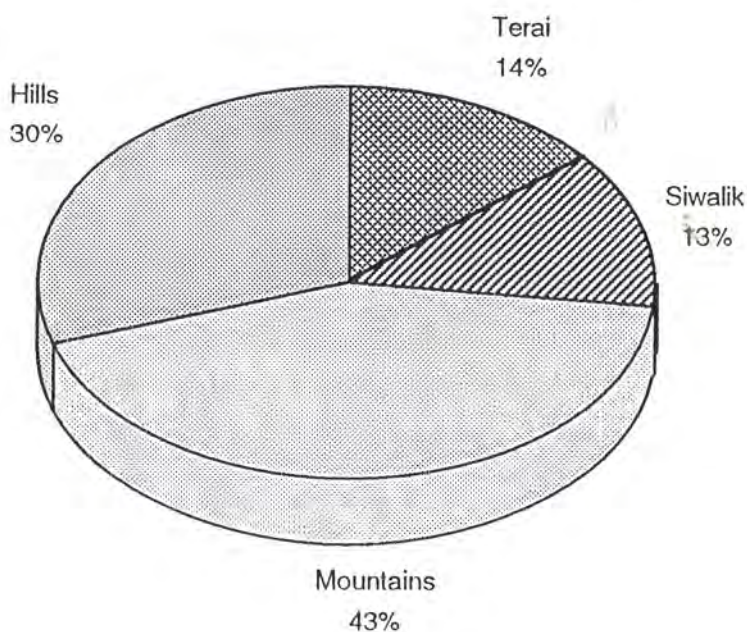
	Width in Km	
	Range	Average of (N)
Great Himalaya Altitude 6,000-8,000 m : High Mt/Glacier	6-87	43.0(7)
Lesser Himalaya (Transition Zone) Altitude 3,000-6,000 m : Sharp ridge and Valleys	17-94	45.0(7)
Main Central Thrust ————— Midland: Middle Mountain Altitude 1,000-4,000 m : Hill Low-lying Valleys	34-64	52(7)
Mahabharat Range Altitude 2,000-3,000 m : Ridges Valleys		
Main Boundary Thrust ————— Siwalik (Churia) Range Altitude 300 - 1,000 m	10-51	26(7)
Terai • Bhabhar Zone • Marshy Midland • Southern Terai	0-45	35(4)

The country exhibits sharp contrast in land forms: (i) below 300 m 12.5 per cent, (ii) 300 m-3000m 60 per cent, and, (iii) above 3000 m 25.5 per cent of the land. The lowest point in the country is in the eastern terai 60 m, midland tectonic valleys 600 m to 1200 m above the mean sea level, while the highest elevations is Mt. Everest at 8,848 m. However, the distance between these extremes is around 200 to 250 km in maximum.

The total area splitted under the physiographic zones are: (i) Mountain 42.8 per cent; (ii) Hills 30.1 per cent; (iii) Siwalik 12.8 per cent; and (iv) Terai 14.3 per cent. In other words the area under mountain 42.8 per cent is equal to the area under Hilly terrain 30.1 per cent and Siwalik range 12.8 per cent collectively 42.9 per cent.

The total area splitted under the physiographic zones are: (i) Mountain 42.8%; (ii) Siwalik 12.8%; and (iv) Terai 14.3%. In other words the area under mountain 42.8% is equal to the area under hilly terai 30.1%. Under Siwalik range 12.8% collectively 42.9%.

Text - Fig. 1 : Physiographic Zone, In percentage



Climate: The climate ranges from the tropical heat and humidity of the Terai to the alpine water climate of the Himalayas and from the very high rainfall to the arid climate.

The country is drained by three major river systems: the Karnali, the Gandaki and the Koshi, the total drainage area of all rivers amounts to about 191,000 sq km, 74 per cent of which lies in Nepal only.

Geological Constitution

As per geological constitution:

- (i) The Siwalik is made up of soft sandstone, mud, sand and gravel.
- (ii) The Mahabharat Range: granite, gneiss, schist, quartzite, slate and phyllite, dolomite.
- (iii) Midland or Middle Mountain: phyllite, schist, brittle dolomite, quartzite.
- (iv) High Mountain and Himalaya: hard rocks at the base and soft marine formations at the top.
- (v) Trans-Himalaya: folded sediments mostly limestone/dolomite.

As a result of the attrition between the South Asian plate and the main Asian plate the geological faults specially the Main Central Thrust and Main Boundary Fault are very active making expressions of earthquakes causing the Himalayas to rise further. The consequent geological instability of the country's land mass leads to continuous erosion; the heavy rainfall and high gradient drainage from the steep mountain slopes contribute to the weathering process which in turn leads to soil formation in the low lands, valleys and the highland terraces.

Pressure on Land

There is no denying of the fact that the mountain terrain compared to the valleys and plains are less productive and as such marginal. The political upsurges seeking expansion to the north and west during the 18th century do indicate that the limit of human occupance in Nepalese hills was already saturated in terms of its carrying capacity; and the forest terrain was recognised as a source of revenue. When the political boundary of modern Nepal was finally limited in 1816 the only alternative to the poverty of the hills was export of muscle power. The number of men recruited in Indian Army during 1886 to 1904 was over 27,000 and around 128,000 in the period (1904-1935) all from the hill (Morris 1936; Gurung 1981). There were numerous attempts to reclaim terai land from forests for resettlement during the Rana regime; however, it remained a negative zone of settlement until the mid 20th country (Gurung, 1981). After the intervention of technology to eradicate malaria implementation of the Rapti Valley Development Project (1959) initiated a major shift of population from hill of the terai.

Watershed Conditions

The watershed condition as per physiographic zones: (i) the Siwalik fair to very poor (ii) Middle Mountain good to fair (iii) High Mountain (Transition zone) good; and, High Himalaya excellent to good. In the hills out of the 36 districts 2 districts (Achham and Dandeldhura) are having class I (excellent) condition; 16 districts are categorised to having class II (good) condition; 10 districts (Parbat, Pyuthan, Khotang, Myangdi, Palpa, Udaipur, Rukum, Dhadhing, Tanahun and Dailekh) are in class III (fair or marginal); 3 districts (Gulmi, Arghakhanchi and Ramdi) in class IV (poor) condition; and 5 districts (Surkhet, Kabhre, Okhaldhunga, Syangja and Nuwakot) belong to class V (very poor) condition (Shrestha et. al., 1983).

Table 2
Watershed condition

Zone	Watershed Condition (Percentage of total area)				
	I-Excellent	II-Good	III-Fair	IV-Poor	V-Very poor
High Himalaya	78	16	4	2	0
Transition (Lesser Himalaya)	52	42	6	0	0
Middle Mountain	14	65	15	6	0
Siwalik	37	28	33	0	2
Terai	100	0	0	0	0

Source: Nelson, 1980

Land Degradation

The degraded land systems recorded are as follows: (Nelson 1980)

1. *High Himalaya Zone: (Trans-Himalaya):*
 - Dolpo Mustang Region;
 - a) Central Dolpo; b) Upper Mustang Valley
2. *High Mountain (Transition zone):*
 - Far Western Transtion Regions - a) Lower Ridges and Valleys

- Lower Transitional Mountain Regions - b) Lower Thulo Bheri; c) Thulo Bheri/Inner Valley
3. *Middle Mountain Zone:*
- Pyuthans Dry Rounded Ridges Regions - a) Gulmi Convex Ridge; b) Gulmi Structurally controlled ridges
 - Central Middle Mountains Region - c) Andhi Khola Mountains
 - Kathmandu Region: d) Indrawati Ridge and Valley; e) Chautara Dolalghat; f) Helambu Ridge lands; g) East side Trishuli River; and h) Dhadhing Ridge;
 - Sunkoshi Region: i) Okhaldhunga-Ramechhap Ridge lands
 - Western Mahabharat Lekh Region : j) Surkhet Mountain Lands
 - Far Western Mahabharat Region : k) Seli-Karnali canyons
4. *Siwalik Zone:*
- Western Siwalik Region : a) Bheri Khola - Karnali Valley
 - Central Siwalik Regions : b) Siwalik Ridges; c) Dang Valley
 - Eastern Siwalik Region : d) Finely dissected lowlands

The watershed conditions are marginal (fair) in 13 districts, poor in 5 districts and very poor in 7 districts. It has been recorded that 18,000 km² of land is in poor condition and is deteriorating at an unknown rate. The watershed condition in the hills are fair to poor and out of the 25 districts having fair to very poor condition, 18 districts (72%) fall in the hilly terrain.

Land Capability

LRMP (1986) has divided land into 7 classes in testing its capabilities: Class 1-3 (4,734,000 ha) 32.1% are suitable for agriculture; Class 4-5 (4,469,000 ha) 30.3% are good for forest and pasture; and, Class 6-7 (5,434,000 ha) 36.8% are unstable and ecologically fragile. (LRMP: 1986 Land capability report).

Land System

A. The land system of the terai:

1. *Active alluvial plain:* It occupies the present river channel. It forms sand and gravel bars, and terraces. It is mostly under maximum flood level-grasses and khair sissoo are the products of this division.
2. *Recent alluvial plains:* It occupies positions of depression, intermediate undertaking and high level. Rice, wheat, maize or diverse cropping are support by it.
3. *Alluvial fan complex:* The features are gentle slopes, undulating or highly dissected land unit. It is the area of tectonic uplift and is towards the foot hill of the Siwalik. It is the belt of the forest.

B. The land system of the Siwaliks:

4. *Active and recent alluvial plains:* It is seen as sand and gravel bars and forms terraces. It produces rice, wheat and forms a belt of natural grasses.

5. *Fans, Aprons and ancient river terraces*: It forms gentle slopes and undertaking rolling land form. Maize, mustard and sal forest are its products.
 6. *Depositional basin (duns)*: It occupies depression or high positions dissected or non-dissected. Rice, maize, and mustard are produced unless it is bad land.
 - 7-8. Steeply sloping hilly terrain: unproductive.
- C. Land system in the Middle Mountains:
9. *Alluvial plain, fans*: river channel or alluvial plains.
 10. *Ancient lake and river terraces*: Dissected or non-directed. Maize, mustard are the products raised.
 11. *Moderate to steep sloping mountain*: Terraces (Irrigated/non-irrigated): Maize, mustard and rice, wheat in irrigated terraces.
 12. *Steep/very steep sloping mountain*: degraded forest belt.
- D. Land systems in the high mountain region
13. *Alluvial plains*: Active alluvial plain and ancient alluvial terraces: Rice in irrigated land.
 14. *Past glaciated mountain terrains*: Moderate/steep slopes. It is below the upper limit of arable agriculture.
 15. *Past glaciated mountain terrain*: Moderate to very steep slopes: Forest/Area of Monsoon grazing.
- E. Land system in the High Himlaya region
16. *Alluvial and morainial deposits*: Glacio-alluvial plains, colloivial slopes (talus), moraine deposits: Area of monsoon grazing.
 17. *Sleep to very steep sloping mountain*: Shallow till or colluvium over bed rock and rock head walls.

Landuse

Following the LRMP (1986) figures the land in use is to be noted as: Forest 37.4 per cent, Shrub or degraded forest 4.8 per cent, Grassland 11.8 per cent, Non-cultivated inclusions 6.8 per cent, Farmland 20.7 per cent, and Other lands 18.5 per cent. The distribution of these components under different physiographic belts as shown in the table below indicates:

1. Forest is equal in the mountain (32.5 per cent), hill (32.8 per cent) and Siwalik together with terai (26.1 per cent and 8.6 per cent = 34.7 per cent).
2. Shrub or degraded forest is conspicuous in the hill (57.2 per cent) and is notable in mountain (34.4 per cent).

3. Grassland (pasture) is significant in the mountain (79.8 per cent) and notable in the hills (15.9 per cent).
4. Non-cultivated inclusions is quite pronounced in the hills (66.8 per cent) and almost equal in the mountain (14.9 per cent) to terai (12.3 per cent).
5. Farmland area may be taken almost equal in the hill (40.1 per cent) and terai (42.8 per cent); and it is also equal in the mountain (8.2 per cent) and Siwalik (8.8 per cent).
6. Area under the category of other land: (a) it is pronounced in the mountain (90.8 per cent); and (b) area under hill (2.2 per cent) and Siwalik (2.7 per cent) = 4.9 per cent may be equated to the area in the terai (4.2 per cent).

Table 3
Land Use by Physiographic Zone in percentage, 1985/86

Physiographic zone	Forest	Shrub	Grassland	Non-cultivated inclusions	Farmland	Other land
Mountain	32.5	34.4	79.8	14.9	8.2	90.8
Hills	32.8	57.2	15.9	66.8	40.1	2.2
Siwalik	26.1	4.1	0.92	5.9	8.8	2.7
Terai	8.6	4.3	3.32	12.3	42.8	4.2
Nepal	5,518	706	1,745	998	3,052	2,729
Total area 14748 (in 000 ha)	(100)	(100)	(100)	(100)	(100)	(100)
Percentages	37.4 %	4.8 %	11.8 %	6.8 %	20.7 %	18.5 %

Source : HMG/ADB/FINNIDA, 1988. Master Plan for the Forestry Sector, Nepal.

Soil Erosion

Soil erosion is a peculiar problem and is a cause for concern in terms of possible acceleration of this process aggravated by human activities which lead to deterioration of soil quality in the hills. However, scientific inquiries regarding this are to be pursued to a considerable extent as there are not representative observations yet to be based. Soil erosion, deterioration of soil quality, water logging along canal system are quite common; and quarrying had led to denudation of hill slopes, excessive erosion, and debris accumulations in the rivers.

Peter Laban (1978) recorded the soil erosion as follows:

	ton/ha
Forest (Managed)	5/10
Paddy Cultivation	5/10
Slopy farm (not managed)	20-100
Pasture (deteriorated)	40-200

CHAPTER 2

Forests and Wildlife

Vegetational Zones

Major forest types in Nepal are tropical, sub-tropical, warm temperate, cool temperate, sub-alpine and alpine. Stainton (1972) broadly classified vegetation of Nepal into 7 divisions on the basis of climatic and vegetational variations; while Dobremez, divided it into 5 zones with ten sub-divisions or levels; later, Malla and Shakya (1968) divided it into three vegetational zones on the basis of distinct climatic variations.

- (a) *Tropical and Sub-tropical Zones:* This zone is predominantly a plain land and is below 1,000 m altitude; the climate is warm and humid; the forests are dominated by *Shorea robusta* (Sal) and other principal associates are *Adina cordifolia*, *Dillenia pentagyna*, *Ternstroemia* spp., *Albizia* spp, *Salmalia malabarica*, *cedrela toona*, *semicarpus anacardium*, *Mallotus philippinense*, etc. Grasslands known locally as "Phanta" have been developed in the Terai, contributing a habitat suitable for wild animals such as swamp deer, rhinoceros, wild buffaloes, tigers etc. A sub-tropical zone lies between 1000 m - 2,100 m altitude and is represented by *Schima-castanopsis* forests in places in the eastern and central Nepal; in the dry hilly regions in the west, this is largely replaced by *Pinus roxburghii*; however, dry Oak forest of *Quercus incana* and *Q. lanata* with some *Rhododendron arboreum*, *Lyonia ovalifolia* etc. occur on the southern aspects.
- (b) *Temperate Zone:* This zone lies between 2,000-3,000 m altitude. It more or less corresponds to the Mahabharat Range. The main forest composition of this belt is of mixed broad-leaved character - *Rhododendron arboreum*, *Acer oblongum*, *Myrica esculenta*, *Michelia kisopa* etc at lower elevations, while the upper belt beyond 1,900 m is usually comprised of evergreen Oaks like *Quercus lamellosa*, *Q. glauca*, *Q. seme carpifolia* and conifers like *Tsuga dumosa*, *Pinus wallichiana*. *Alnus nepalensis* forests are frequently seen in patches, at gullies and stream sides. The distribution of typical west Himalayan conifers, such as *Cupressus torulosa*, *cedrus deodara*, *Picea Smithiana* and *Abies pindrow* and the temperate deciduous trees like *Juglanis regia* and *Aesculus indica* are characteristics of the western temperate regions.
- (c) *Sub-alpine and Alpine Zones:* This zone begins from about 3000 m upwards to the snowline. The climate is extremely cold and snowy. The sub-alpine belt extends to about 3,700-3,900 m altitude. The vegetation is dominated by *Abies spectabilis*, *Betula utilis*, along with *Rhododendron* spp. as the understorey, continuing up to the timber line. The alpine zone comprises various stunted bush-like *Rhododendron setosum*, *R. lepidotum*, *Potentilla fruticosa*, *Polygonum vacciniifolium*, *Hippophe rhamnoides*, *Ephedra gerardiana* etc. along with most reputed herbs. Trans-Himalayan areas like Dolpa, Manang and Mustang in the north-western region of Nepal, lying north of Dhaulagiri and Annapurna massif, are typically arid and windy. Alpine steppe vegetation, comprising grasses and sedges, is a characteristic feature of the natural vegetation with cushions of *Caragana brevifolia*, *C. gerardiana*, *Lonicera spinosa*, *L. myrteloides*, *Myricaria rosea*, *Astragalus*, *Jumiperus*, *Berberis*, *Sophora moorcroftiana*, etc also being commonly distributed in this area. *Kharka*, grazing land, is also an important feature of these areas.

Forest Density

There are 5.5, 1.7 and 0.7 million ha of forest land, grassland and shrub land respectively; and of the 5.5 million national forest 59 per cent is of hardwood, 24 per cent is mixed and 17 per cent belongs to the conifer species. Hardwoods are dominant in the Terai and lower Hills while conifers occur at higher elevations. The midland and Siwalik are equally affected in the loss of forest during the period 1973-1985. Regarding forest density (crown percentage) 59 per cent has medium crown cover, 15 per cent constitute high crown cover, the rest of the forest land being degraded. High density forests are left only in the protected forests in the Terai or in inaccessible areas in the mountains.

Table 4
Change in Forest Land ('000 ha)

Zone	Percent Change				
	1978/79	1985/86	Change	1973-85	Annual
High Himal and High Mountains	1,782	1,789	+ 7	0.5	0.0
Middle Mountain	1,791	1,781	- 10	- 0.6	0.0
Siwaliks	1,445	1,434	- 11	- 0.8	1.1
Terai	587	445	- 142	- 24.1	- 3.9
Total	5,605	5,449	- 156	- 2.8	- 0.4

(After UNCED (1992), p.33)

Table 5
Forest Density According to Crown Cover

	Nepal	High Himalaya	High Mountain (Lesser Himalaya)	Middle Mountain	Siwalik	Terai
AREA	14.7 m ha	23 %	20 %	30 %	13 %	14 %
Forest	5.5 million ha	3 %	30 %	33 %	26 %	8 %
CROWN %						
70-100 High	15.3 %	23.8 %		8.2 %	10.0 %	24.2 %
40-70 Medium	58.6 %	48.2 %		55.2 %	70.4 %	65.2 %
10-40 Low	26.1 %	28.0 %		36.5 %	19.5 %	10.7 %

(After LRMP (1986) and UNCED (1992), p.6)

The ratio of the cultivated land and forest land in the different physiographic region is quite important as forest provides the life support system to agricultural productivity; Nield, R. S. (1985) records the ratio as 1:2.12 for Nepal, 1:1.8 for middle mountain and 1:0.48 for terai; whereas recent study carried out by the Hill Forestry Development Project in Pokhara and Palpa found the ratio between agricultural land and forest land to be 1:1 and in the majority of cases it was less than one. It is being recorded that diversity of the genetic materials (rich flora and fauna) at different altitudes and areas could be essential to improve the yield and quality of crops.

Fodder Requirement

Over 75 per cent of the people still depend on fuel wood to meet their energy requirements; the annual per capita fuel wood consumption in the hills is about 708 kg whereas it is 689 kg in the Terai. The livestock sector is heavily dependent on forests and grasslands; around 42 per cent of the total TDN (Total Digestible Nutrients) requirement is estimated to be met from the forestry sector. In 1990-91 the total number of livestock in terms of livestock unit (LU) was estimated to be 9.8 million and it is expected to reach 11.6 million by the year 2000 AD. The fodder requirement or total digestible nutrients (TDN) is obtained from the accessible forests, shrub lands and grasslands; a total of 1.88 million tons of TDN is supplied from accessible forest; and the Hill Region alone supplies 50 per cent of the total TDN requirements. The TDN requirement was about 6.08 million tons in 1985 and has reached 6.39 million tons by 1990. In line with livestock production, the pressure is high in the hills and in the Central Development Regions. Annual tree plantation in the country covered only 10,000 ha during 1979-86; the present plantation rate is less than the deforestation rate; and the demand-supply situation of forestry products in the country is not favourable. LRMP observed middle hills as having acute situation in terms of demand and supply ratio of fuelwood/timber that being 2.3:1 and in some district it is 4.1:1. There is an urgent need to further expand afforestation programme. This calls for an action plan that can combat the environmental deterioration caused mainly by the ever increasing demand for timber, fuelwood, fodder and medicinal herbs. Towards that preference need to be given to fast growing indigenous species as far as practicable. Exotic varieties that have already been found suitable to Nepalese conditions, could also be planted.

Protected Areas

The immense bio-climatic diversity supports more than 35 forest types of which 25 are confined to mountain parks and reserves. The Narayani basin contributes the meeting point between the two extremities of the western and eastern Himalaya. The Langtang National Park in the Central Himalaya lies in the eastern floristic regions; Sagarmatha National Park falls in the eastern Himalayan region; Shey Phoksundo National Park and Dhorpatan Hunting Reserve lie at the boundary of the eastern and western Himalayan floristic regions; and Khaptad and Rara National Parks lie in the Western floristic region. About 16 forest types and 20 endemic plants are found in the Rara Park. Khaptad Park is known for its highland meadows and coniferous forests. The terai is richer in mammal species than the Himalaya; about 175 species of mammals, 850 species of birds, 600 species of butterflies, 50 species of moths, 180 species of dragon flies, 170 species of fishes and three large reptile species are found in Nepal.

Table 6
Protected Areas of Nepal

Name	Sector	Category	Gazetted	Area Km ²	Revenue (in Rs.)	1988/89 (in %)
A. Mountain				12,774	9,786,163	81.8
1. Rara	West	National Park	1976	106	30,503	0.3
2. Shey-Phoksumdo	West	National Park	1984	3,555	8,050	0.1
3. Dhorpatan	Central	Hunting Reserve	1987	1,325		
4. Annapurna	Central	Conservation Area	1986	2,600	7,358,500*	61.5
5. Langtang	Central	National Park	1976	1,710	985,320	8.2
6. Sagarmatha	East	National Park	1976	1,148	1,403,790	11.7
7. Makalu-Barun	East	National Park and Conservation Area	1991	2,330		
B. Hill				370		
8. Khaptad	West	National Park	1984	225	1,335	0.0
9. Shivapuri Watershed	Central	Wildlife Reserve	1983	145		
C. Inner Terai						
10. Chitwan	Central	National Park	1973	932	2,033,730	17
D. Terai				1,797	143,945	1.2
11. Sukla Phanta	West	Wildlife Reserve	1976	155	21,695	0.2
12. Bardiya	West	Wildlife Reserve	1976	968	119,050	1.0
13. Parsa	Central	Wildlife Reserve	1984	499	50	0.0
14. Kosi Tappu	East	Wildlife Reserve	1976	175	3,150	0.0
Total				15,873	11,965,173	

* For 1989 vide Annapurna Conservation Area Project

Other revenue data on entrance and camping fee from Department of National Parks and Wildlife Conservation

Source : IUCN (Prof. Malla's compilation)

In Nepal there are 26 types of mammals, nine species of birds and three types reptiles in the protected list; and thus, National Parks and Wildlife Reserves are serving as a "natural gene bank".

Some of the protected species are: (i) Mammals - *Rhinoceros unicornis*, *Bos gaurus*, *Elephantus maximus*, *Panthera tigris*, *Moschus moschiferus*, *Panthera uncia*, *Canis lupus*, *Platinistat gangetica*; (ii) Birds – Impeyan pheasant, Crimson-horned pheasant, Bengal florican, Great piped hornbill, Black/White stork, Sarus crane, Cheer pheasant, and Lesser florican; and (iii) Reptiles – Python, Gharial crocodiles and Golden lizard.

The protected area 15,873 km² is around 10.8 per cent of the country's total area : looked into its distribution it is significant in the mountain 80.5 per cent, notable in the terai (including inner terai) 17.2 per cent and poorly represented in the hilly terrain being 2.3 per cent of the total protected area.

CHAPTER 3 Inland Waters

Inland Waters

The rivers of Nepal developed by the monsoon regime after the emergence of the Himalayas may be classified (Sharma 1977) as:

River originating from different locations

1. New	Originating from Terai
2. Post Siwalik (Churia) (Pleistocene - Recent)	Originating from Churia
3. Post Mahabharat Range (Oligocene - Miocene)	i) the Kankai; ii) the Kamala; iii) the Bagmati; iv) the Tinau; v) the Babai.
4. Pre-Himalayan: antecedent (Cretaceous to Eocene)	i) the Koshi; ii) the Gandak; and, iii) the Karnali.

Table 7
Glacier and their distribution

	Range	Length in Km	Height in Metre	
		Average of (N)	Maximum Range	Minimum Range
1. Kanchenjunga - Lumba Sumba Region	4-20	12 (23)	6,000-8,000	4,000-5,700
2. Langtang - Ganesh Himalayan Region	5-18	9.1(10)	6,000-6,500	3,850-4,200
3. Manaslu - Annapurna Region	4.2-14	8.1(11)	6,000-7,000	3,700-5,000
4. Dhaulagiri Region	5-11	6.75(4)	5,850-7,500	3,300-5,490
5. Kanjiroba Region				
6. Api Nampa-Saipal Gurla Mandhata Region	3.5-9.0	6.0(5)	6,000-6,100	4,000-5,700

Lakes: Lakes above 4000m altitude in the north are mostly of glacial origin; tectonic lakes are found in the midland and ox-bow lakes occur in southern terai plain.

A. Glacial Lakes:

(i) Raradah (north of Jumla) 6km x 1km in dimension; (ii) Phewatal, Begnas, Rupatal (Pokhara); (iii) Clusture of big lakes (north of Kathmandu): 1. Gosainkund; 2. Bhairavkund; and 3. Surajkund. (iv) Ruyani Lake clusture; (v) Ghat Khola Lakes (head of Barigad); (vi) Baragaon Lake (Bheri River); (vii) Jagdu Khola Lake (Kanjiroba Himal); (viii) Tilichho Lake (Muktinath Himal); (ix) Phoksumdo Tal (Selvia Bhanjyang); (x) Tongu Tal (Mukut Himal); (xi) Dudhpokhari (Marsyangdi River); (xii) Kalo Seto Lake (Ankhu Khola); (xiii) Bridang Kund (Ankhu Khola); (xiv) Kalchuman (Burigandaki); (xv) Chemo Himal Lakes (Dudh Keshi: Marsyangdi); and, Bhimtakothi; (xvi) Jageshwar Kund (Trishuli); (xvii) Panch Pokhari (Dorje Lakpa Himal - Watershed of Indrawati); (xviii) Panch Pokhari and Jata Pokhari (Khimti Khola: Tamakoshi); (xix) Panch Pokhari (Mt. Everest); and, (xx) Trapped river lake: Khaptad Lake (Doti).

B. **Tectonic Lakes:** (Midland) Lakes are now drained out.

(i) Kathmandu Valley; (ii) Panchkhal; (iii) Banepa; (iv) Pokhara Valley;
(v) Mariphant (Tansen); (vi) Dang/Surkhet Valley;
(vii) Mai Pokhari (Ilam); and, (viii) Raja Pokhari (Churia East).

C. **Ox-bow Lakes:** Numerous ox-bow lakes are found in Terai plain which indicate periodic shift in river courses.

Aquatic Resources: (Fisheries Development Division, 1993):

Rivers cover an estimated area of about 395,000 ha, irrigated paddy fields 325,000 ha, and marginal swamp 12,500 ha. The growth of hydro-electric power stations and irrigation projects is to add more water bodies on various river basins and system - say 78,000 ha of reservoirs upon their completion. Collectively, these water bodies cover nearly 3 per cent of Nepal's land area. It is estimated that some 500,000 ha. of water surface may be available to fish production, of which approximately 100,000 ha would be lakes, reservoirs and village ponds (NARC, 1989). The existing water resources of the country and their future potential reveal that there is a tremendous scope for expansion as well as intensification for fish production in the country as shown in the table below:

Table 8
Estimated Water Surface Area in Nepal (FDD, 1993)

Resource Details	Estimated Area. (ha)	Coverage %	Potential Area (ha)
1. Natural Waters	401,500	54	
1.1 Rivers	395,000	53	
1.2 Lakes	5,000	0.7	
1.3 Reservoirs	1,500	0.2	78,000
2. Village Ponds	6,500	0.9	14,000
3. Marginal Swamps around irrigated fields	12,500	1.6	
4. Irrigated rice fields	325,000	43.6	
Total	745,500	100	92,000

(After : Nepal Final Country Report, 1994)

Aquatic and Marshy Fauna and Flora

Numerous aquatic and marshy fauna and flora are found in the rivers, lakes and ponds of Nepal. In the northern region of the country where water temperature is found to reach near the freezing point, very few fauna and flora are noticed. The fauna of the Trans-Himalayan, Himalayan or High Mountain Wetlands include Snow trout *Schizothorax*, sucker head Garra, stone-loach *Noemacheilus*, etc. Among amphibians, Himalayan toad (*Bufo himalayanus*) is represented.

The biota of wetlands of the midlands are biologically diverse: concentration of planktons and various adaptations of these miniature forms in response to changing ecological conditions may be displayed. Deep water lakes teem with a broad spectrum of algae-*Spirogyra*, *Oscillatoria*, *Chlorella* and *Prasiola hydradiction* etc. Besides, diatoms of family *Bacillariophyceae*, rotifers, hydrozoan coelenterate are notable. In shallow water lakes with moving water, a variety of insects are known; theses include larvae of fly (*Perla*), Mayfly (*Ephemera*), riffle beetle (*Psephenus*), Shrimps (*Peneaus*), crabs (*Cancer*) etc. All

these indicator species contribute greatly to the food chain in wetland ecosystem. Fishes of different varieties *Schizothorax* sp., *Catala* sp., *Tor* sp. are found in big rivers and lakes; small size fishes include *Clupisoma* sp., *Aila* sp.

The lowland tropical lakes are laden with phytoplankton and zooplankton. The swamp bogs and water logged depressions support diverse reptilian species. In the rivers and lakes different types of fishes such as *Labeo* sp (Rahu), scaleless fish, wallago (Buhari), *Mystus* (kanti), *Rita* Sp. (Rita) and *Cirrhinus* sp. (rewa, Naini, Mrigel) are noted. In the ponds of Terai the common fishes are clay fish which locally called Bhoti or Girahi. Big ugly fish *Bagarius bagarius* (Gonchh) is found in the big rivers like Karnali and Narayani. Dolphins (*Platanista gangetica*) locally called "Sus" is found only in the Narayani river. Crocodiles are found in Narayani and Karnali rivers. They migrate 10 to 20 miles either north or south conditioned with the temperature of water. Migratory ducks are found in hundreds in the Rapti and the Karnali rivers; whereas these are few in the Narayani and Koshi rivers. Egrets are found in Marshy area. Tortoise are found in the ponds and lakes of Terai. Yellow big frogs which are delicacy for the mountain people are found in the river valleys of the mountains. Swampy fauna like swamp deers are found in Shukla phanta; wild buffaloes are found in the inland of the Koshi river.

Flora: In the terai elephant grass, Ank and reeds are found along the river banks; and amongst the large trees *Acacia catechu* (Khair), *dalbergia*, *Sisso* (Sisso) are found. In the lakes of the terai lotus and *singara* plant and *jal khumbi* are found in plenty. Typical grasses locally called "gund" and "cane" grow in the swampy area.

The managed wetlands (fish ponds, rice paddy fields) are stocked with variety of fishes- murrel (*channa maurilus*), mud eel (*Amphipnous cuchia*), walning catfish (*Clarias batrachus*), and cat fish (*wallago attu*). Besides these species many riverine species such as catla (*catla catla*), *Rho labelo rohita* and exotic fish species *Cyprinus carpio* have also been stocked in cages and fish pens. Integrated aquaculture such as fish-cum duck culture, fish cum pig culture have been practiced. The artificial wetlands (reservoirs, sewage ponds and tanks, have been useful habitat for fish and aquatic birds.

Species Cultured

Seven species of commercially high-valued carps are being cultured for aquaculture practices in Nepal. They include three indigenous species: (a) Rohu (*Labeo rohita*); (b) Naini (*Cirrhina mriga*); and, (c) Bhakur (*Callacatla*); and Four exotic species: (i) Common carp (*Cyprinus carpio*); (ii) Silver carp (*Hypophthalmichthys molitrix*); (iii) Big-head carp (*Aristichthys nobilis*); and (iv) Grass carp (*Ctenopharyngodonidella*).

Culture System and Methods

Major aquaculture systems being adopted are : (i) Carp polyculture in ponds, (ii) Carp polyculture in lake enclosures, (iii) Cage culture of planktivorous carp species (major species: silver carp and big head carp); (iv) Common carp in rice cum fish culture. The majority of carp polyculture ponds are located along the southern belt (terai and inner terai) of Nepal because warm climatic condition exist in these areas. The cage culture and enclosure farms are exclusively located in the mid-hill regions.

Silver carp and big head carp contribute a major share (about 45 per cent) while common carp and indigenous major carp contribute about 24 per cent each, and grass carp contribute about 5 per cent only in the total fish production from aquaculture in Nepal. Around 12,240 families have been

estimated to be engaged in this profession. From this about 61,700 to 73,500 people are estimated to be directly benefitted in the country.

Chemotherapeutants

Over the last two decades aquaculture operations in the lakes around Pokhara appear to have utilised increased nutrient inputs from sewage and fertilisers into fish production. Thus the utility of this activity has been very significant in maintaining the ecological balance of lakes and their surrounding environment. There are a number of chemicals used in aquaculture in Nepal (see below). However, so far no significant impacts on the environment have been recorded.

Table 9
Dose and purpose of the chemicals used

Name of Chemical	Dose Rate	Purpose
Lime	500 kg/ha/yr	Pre-stocking operation for extensive/semi-intensive/intensive ponds
Nitrogen fertiliser	220 kg/ha/yr	Post-stocking operation for intensive/semi-intensive ponds
Phosphorus fertiliser	345 kg/ha/yr	Post-stocking operation for intensive/semi-intensive ponds
Malachitegreen	0.1-1ppm	Treatment against parasites
Trichlorfon	0.25 ppm	Treatment against parasites
Copper sulphate, formalin, KMnO_4 , dipterex, neguvon, terramycin, tetracycline, acriflavine, and common salt (NaCl) are also used for treatment of disease. Malathion is also used to control pond predators.		

(After : Nepal Final Country Report 1994)

No significant interactions between aquaculture and indigenous fish, have been recorded. The government has introduced tilapias for experimental purposes but so far these fish have not been released to the private sector (because of concerns over potential negative impacts on wild fish populations).

Cage and Pen Culture

Cage fish culture (introduced in the lakes of Pokhara) has been considered to be a remarkable step towards the development of natural water resource management for aquaculture production in the country. The cage fish culture in lakes with planktivorous carps (major species: silver carp and big-head carp) has been quite successful. This has been recognised to be economically viable also (Pradhan, 1979). This important characteristic of three lakes (under cage culture of carps) as reported by Fisheries Research Centre, Pokhara for 1991/92 are given below:

Table 10
Physical and Limonological characteristics of lakes

Particulars	Phewatal	Begnastal	Rupatal
Air Temperature (°C)	8.0 - 33.0	9.0 - 32.2	9.0 - 31.0
Altitude (M)	742	650	600
Area (ha)	523	328	135
Max. Depth (M)	24	10	6
Av. Depth (M)	7.5	6.6	3
Length (M)	3100	1700	2800
Breadth (M)	1300	1500	400
Maximum Temp. (°C)	29.5	32.0	30.0
Minimum Temp. (°C)	15.0	15.2	14.0
pH	7.0 - 8.8	6.4 - 8.5	5.6 - 7.8
Transparency (M)	1.5 - 3.3	1.2 - 3.4	0.8 - 1.8
Dissolved Oxygen (mg/l)	6.1 - 12.3	5.3 - 14.3	5.0 - 8.9
Watershed Area (km ²)	110	19	30

(After : Nepal Final Country Report, 1994)

Impact of Environment

As a result of massive deforestation activity in lake catchment areas and heavy rain during the monsoons, there have been severe landslides and soil erosion. The surface run-off water from these areas carry enormous amount of silt and organic waste and drain into the lakes. Siltation problems are particularly acute in Lake Phewa and Rupa in the Pokhara Valley.

Increased agriculture activities, unplanned urbanisation and development of the tourism industry in the vicinity of Pokhara Valley have begun to generate serious environmental threats to the lakes. These activities have resulted in increased draining of agro-chemicals and urban sewage during the flood season and have been the cause of increased pollution in the lakes. Collectively, such environmental problems not only have caused adverse effects on the ecology of lakes and the surrounding environment but also have impacts on aquaculture developmental activities in the lakes.

High siltation appears to have damaged the breeding areas of important indigenous fish species endangering their existence in the rivers. The construction of irrigation dams and diversion of rivers for power generation have caused adverse impacts on river ecosystem and migrating indigenous fish stock. The ponds in the terai and inner terai suffer from physical changes-flooding and heavy siltation during monsoons and drought during the dry seasons.

CHAPTER 4

Coastal and Marine Environment

CHAPTER 5

Atmosphere and Climate

Monsoon

The climate in Nepal is controlled by the monsoonal winds and altitudinal variations. The monsoonal wind result from an inland low pressure developing in the summer and are accentuated by a northward migration of air from the southern hemisphere. These are south to southwesterly winds which carry moisture from the Indian Ocean to the Himalayas. The wet season is from June through September. Rains brought by these winds are characterised by being strongly seasonal, quite variable in amount and torrential at lower elevation. These rains begin early (in April) and end late in September in eastern Nepal. The general precipitation pattern is for diminishing amounts and duration as one moves towards the north and west. There is a winter monsoon resulting from west winds from the Arabian Sea Area. This is strongly expressed in western Nepal where up to 10 per cent of the annual precipitation comes during the winter months.

Regional Climate

Physiography has both a regional and local effect on climate. The major climatic zones are controlled by the elevation. The annual snow line is at about 3,000 meters and the permanent snowline, above which lies 15 per cent of the country, is at 4,700 meters. According to Stainton (1972) there is a continuous summer cloud level at about 2,700 meters which shrouds the high peaks. Crops do properly above this elevation in most of Nepal. Stainton also noted that precipitation-intensity decreases with increase in elevation and that in the higher parts of Nepal (about 3,000 meters) misty drizzles are a major form of precipitation.

Regional climate is strongly influenced by the mountain ranges. The luff and lee effect is visible both in the Himalayas and the Siwalik-Mahabharat ranges. A classic rainshadow is created by the High Himalayas. The often cited example is between Pokhara with 347 cm of average mean annual precipitation in front of the Himalayas, and nearby Jomosom in the Kali Gandaki Valley behind the Annapurna Himal with 29 cm of precipitation. A somewhat weaker pattern exists in relation to the Siwalik-Mahabharat ranges.

The orographic effect of mountain ridges has been noted by the higher precipitation at stations at the foot of the mountains, both Himalayas and Siwaliks, than at stations at greater distance from the mountains. Biratnagar and Dharan are an example of this: 168 cm at Biratnagar, 30 km south of foothills; and 236 cm at Dharan at the base of the Siwalik hills.

Climatic Pattern

Domros (1977) describes many valleys in the Himalaya Mountains as being exceptionally dry because both during day and night time breezes ascend. This causes locally heavy precipitation from thunder showers on the slopes and ridge tops but maintains a dry, nearly desertilike valley bottom. Cloud patterns on satellite imagery made during the monsoon verify these observations. One result of such a pattern is a significant under-estimation of annual precipitation because most precipitation recording stations are in valley bottoms.

The local climatic pattern is also strongly influenced by slope aspect. The south slopes have a higher rate of insolation, resulting in higher evaporation rates. This in turn is reflected in the greater sparsity of vegetation of south-facing slopes in comparison with north-facing slopes. The difference in vegetation between north and south slopes becomes more vivid as one moves from east to west.

There is thus a great variety of climatic pattern; during the pre-monsoon season (March to May) thunderstorms are frequent; Monsoon commences in mid June and continues till mid-September. The summer monsoon and winter rains amount to about 85 per cent and 15 per cent of the total annual precipitation respectively. The average annual rainfall ranges from about 250 mm in the dry regions to about 4,500 mm in the humid regions. Thus with a wide diverse topography the temperature in Nepal ranges from tropical heat with 30°C in summer and 15°C in winter, to the Arctic frost, below 0°C through the year. Wind speed varies with altitudes, and in general it is about 50 to 60 km/h at 6 km elevation and can reach 120 km/h at the summits (Ramanathan 1977, p. 70).

Melt water

Upper air observations made in Nepal (Sharma 1993 p. 114) indicate the annual variation of freezing level from about 3,000 to 6,000 m, as such this range of altitude plays an important role in the contribution of melt water to the rivers downstream. The areas within the altitude range of 3,000 m and 6,000 m are about 53 per cent, 45 per cent and 61 per cent in the Karnali, Narayani and Koshi basins respectively.

The annual hydrograph among the three major snowfed basins and the average rain fed rivers shows: (1) Narayani basin has the highest annual discharge; (2) the Koshi has the lowest; and, (3) the Karnali has low discharge. The hydrograph indicates that the role of monsoon rainfall is more dominant compared to the role of snow.

The low flow period before the onset of the summer monsoon is critical for most of the water resources projects. Since it is the time, of the annual maximum temperature, the melt water contribution becomes significantly important for the development of water resources. Melt water contribution is the highest in the month before the onset of the monsoon exceeding 30 per cent of overall average of the monthly average discharges. Ground water is the primary source for the maintenance of base flow in all the major rivers in Nepal.

Climatic Zone

The agro-climate zone of Nepal (APROSC, 1990) have been worked out under several parameter: i) temperature regime, ii) humidity regime, iii) main growing days, and iv) average temperature; thus the sub-tropical and the temperate regions are further splitted into 3/4 sub units.

Based on Monsoon Asia by Robinson (1967) the following divisions may be worked out: a) *Sub-tropical monsoon*: The terai and associated inner valleys are areas of strong seasonal change; the hot season (June to September) has the temperature range 25°C-32°C - the mean annual being over 21°C; the rainfall is 110 cm in the west and 200 cm in the east; and the dry season (October to May) is the period of westerly winds. b) *Temperate Monsoon*: The central part has warm wet summers and cool dry winter. This is the largest climatic region in Nepal. Night time winter temperature goes down below 4°C. c) *Alpine*: This climatic belt prevails between 4,000-8,000 m. The short summers are cool; winters are cold and snow storms are common. d) *Tibetan*: This is the rain shadow region of the Himalayas, precipitation being less than 500 mm; and Mustang - Dolpo area is the best type

representation. Summers are cool and winters are cold. Temperature differences are pronounced between sun and shade and between night and day.

Indoor Air Pollution

Indoor air pollution caused by combustion of biomass fuel for cooking and heating purpose in rural household has been studied in various parts of Nepal. There is relatively high level of respirable hydrocarbons, particulate of several categories as well as CO. Poor ventilation contributes to high concentrations of emission within rural houses, particularly in kitchen. Davidson (1986) measured concentration of different air pollutants in 18 houses in several villages including high altitude village such as Lukla, Namche; concentration of suspended particulates were in the range of 3-42 mg/m³; high concentration of several trace elements were also found; data for gaseous species show appreciable levels (21-37 ppm) of CO, CO₂, methane and several non-methane hydro-carbon. In summary there is high indoor pollutant concentration including particulate species such as trace elements, SO₂, NO₃ and carbon, as well as gaseous species such as CO and volatile hydrocarbons. The indoor emissions also influence the outdoor environment, creating a visible haze in the more populated areas of the Himalayas. High and outdoor concentration of potassium and methyl chloride is as well traceable to biomass combustion.

About 82 per cent of the urban households depend on fuel-wood for cooking purposes. If Kathmandu is to be taken as a typical example they are increasingly becoming more dependent on kerosene, say 36.5 per cent. The smokeless chulo, chimney and use of kerosene when used in absence of good ventilation are potential source of indoor pollution.

The composition of major pollutant emissions from different type of traditional fuel sources, based on Indian study, (Table 48 p.123 EMAG) indicates that firewood, most common form of fuel source in urban areas, is the worst (in terms of pollutants emitted) among the three sources taken.

Table 11
Estimated Emissions of Major Pollutants From Non-Commercial Sources

	(Kg/ton of fuel)		
	Firewood	Dry cattle dung	Agricultural waste products
Carbon monoxide	1.63	0.691	1.594
Sulphur dioxide	19.60	8.182	18.750
Nitrogen oxides	3.90	1.636	3.750
Organic (including hydrocarbons)	23.50	9.818	22.050
Particulate	31.40	13.091	30.000
Hydrogen sulphide	1.20	0.454	1.125
Ammonia	1.20	0.454	1.125
Hydrogen chloride	1.20	0.454	1.125
	83.63	34.780	79.519

Source : PARIKH, 1977(After EMAG 1992, Table 48, p. 123)

Outdoor Pollution

Dhamala (1983) estimates that in Kathmandu Valley alone, each year 22,000 tons of CO, 4,000 tons of Nitrogen oxides and 333 tons of sulphur oxides and particles are emitted by automobiles.

The number of industries located in the urban centre has increased dramatically. Sporadic studies indicate that two major cement factories (Chobar and Hetauda) emit dust at a rate of 4.5 gm/cum and 0.1 gm/cum respectively.

Table 12
Composition of Emission Gases of Cement Industries

Industries	SO ₂ ppm	NO ₂ ppm	NO ppm	CO ₂ %	CO%	O %	N ₂ %	Moisture %	Dust g/n/m3
Himal Cement (before expansion)	5	30	20	16.4	2.6	10.9	70.1	19.5	4.5
Hetuada Cement	50		150	18.42	0.1	10.4	59.72	14.42	0.1

Source: Industrial Service Centre, 1987 (After EMAG, 1992, Table 45, p.120)

Recent survey conducted by NECG (EMAG 1992, p.119) indicates that out of a total 125 industries surveyed as point sources of pollution, 105 industries (84%) are having air pollution problems. The dust particles suspended over the busy roads have been studied at selected spots of Kathmandu, Pokhara and Biratnagar.

Table 13
Air Particulates Trapped in Kathmandu, Pokhara and Biratnagar

Location	No. of Carbon Particulates per mm ² /hr	No. of Silt Particulates per mm ² /hr	Concentration of Particulates mg/m ² /hr
Kathmandu			
• Kalimati	33750	45000	18.2
• Gaushala	22500	18750	7.8
• Ratna Park	26230	30000	15.3
• Pakanajole	11250	22500	7.2
• New Road	18750	37500	16.3
• Maharajgunj	26250	33750	11.1
Pokhara			
• Prithiv Chowk	53682	18750	18.67
• Mahendra Pool	15000	8250	13.3
• Bag Bazar	3750	7500	8.0
• Bagarchowk	3570	15000	10.67
• K.I. Singh Pool	3750	7500	5.33
• Phewatal Side	7500	3750	4.01
• Pokhara Industrial State	8250	3750	11.73
Biratnagar			
• Tinpaine	3750	15000	5.35
• Sankerpur	7500	8250	10.67
• Rangeli Road	7500	8250	6.01
• Mahendra Chowk	33750	52500	17.32
• Raghupati Jute Mill Area	22500	18750	8.0
• Teen Tolia	3750	7500	7.6

Note : No of other particulates are too much to count (TMTc)

Source : CEDA (1990) A Study on the Environmental Problems due to Urbanisation in Some Selected Nagar Panchayats of Nepal, CEDA, Nepal (After EPC 1992, Table 2.1.3 p. 20)

Anthropogenic emission of carbon dioxide to the atmosphere has been estimated to be 0.27×10^6 tons (total), and 0.01 tons per capita for Nepal (United Nations World Energy Data base, 1988; After EMAG, 1992, Table 46, p.120). The composition of fuel gas emission of the two cement factories, Nepal Vegetable Ghee Industry and Bansbari Shoe and Tanning Factory clearly indicate that the emitted gases such as SO_2 , NO_2 exceed the limit permitted in other countries. All these factors - industrial emissions, vehicular exhaust, scattered garbage, dirt surface roads and the burning of refuse - produce air pollution the magnitude of which has not been fully and systematically ascertained in any town.

The World Resources Institute (WRI 1990) estimated Nepal's (1987) contribution to the global greenhouse effect through the emission of CO_2 (expressed in terms of total carbon content), methane (CH_4), and chlorofluorocarbons (CFCs). Nepal's anthropogenic additions to the CO_2 flux included 14,000 tons of carbon from cement production, 62,000 tons of carbon from combustion of solid fossil fuels, 150,000 tons of carbon from combustion of liquid fossil fuels, and 6.7 million tons of carbon from annual land use changes, totaling 6.9 million tons of carbon. The total CH_4 emission for Nepal included 38,000 tons from solid waste, 490,000 tons from livestock and 660,000 tons from wet rice.

CHAPTER 6

Wastes, Toxic and Hazardous Chemicals

Solid Wastes

It is estimated that around 40 per cent of the wastes generated in the towns are collected; the remainder is either dumped in the nearby rivers like the Vishnumati or left to decompose on streets and open spaces. Out of the 33 municipalities the percentage of collections are: Lalitpur 90 per cent, Kathmandu 85 per cent, Bhaktapur 67 per cent, Nepalgunj 43 per cent, Birganj 29 per cent, Pokhara 4 per cent, and, Biratnagar 2.5 per cent. The solid waste deposited on the bank of Vishnumati is made up of : i) Soil dirt 36.6 per cent, ii) Stones 35.5 per cent, iii) Bones 15.3 per cent, iv) Clothes 5.0 per cent, v) Paper Card Board etc 4.1 per cent, vi) Plastics 2.8 per cent, vii) Metals 0.9 per cent, and, viii) Glass 0.6 per cent; the total sample analysed was 436.7 Kg (*EPC, 1992 Table 2.3.14 page 60 Reorganisation of Solid Waste Disposal in the Kathmandu Valley 1982*).

The percentage of biodegradable and non-biodegradable contents observed at Kathmandu, Pokhara, and Biratnagar are almost similar: the degradable content is in the range of 76.7 to 78.5 per cent and non-degradable component varies from 21.5 to 23.3 per cent (CEDA, 1990; After EPC, 1992 Table 2.3.14, pp 60-1). The type, quantity of wastes of some of the industries in Kathmandu, their reuse practices or mode of disposal are illustrated below.

Table 14
Type and Quantity of Wastes of Some Industries

Name of Industry	Production Output	Industrial Type and quantity of wastes	Solid Wastes re-use practices	Methods currently used
Bansbari Leather and Shoe Factory	250 pairs shoes/day	Fleshing 1.5 ton/day	Split skins are sold for dog food production	Open dumping on site
		Chrome dust 200 Kg/day		Dumped with fleshing
Himalayan Brewery (Godavari)	1.5 x 10 ⁶ Ltr beer/year	Solid Wastes	Solids are used for animal feed and compost	
Himal Cement Factory (Chovar)		Solid Wastes	Solids are sold for use in roads surfacing	
Harisiddhi Brick and Tile Factory (Harishidhi)	Bricks and Tiles	Solids from clinker 800 ton/yr	Ashes are used as soil conditioner of fields	Sold
		Coal ash 400 ton/yr		Sold
Kathmandu Milk Supply scheme	2.2 x 10 ⁵ Ltr milk/year	Broken bottles and plastic	Bottles are reused	Sold
	1.1 x 10 ⁵ Kg bottles/yr	Bags 465 Kg/day		
Modern Slipper Industry (Bansbari)	6 x 10 ⁵ pairs/year	Solids (Mixture of raw materials) 1 ton/year		Untreated onto river bank

Table 14 Cont.....

Name of Industry	Production Output	Industrial Type and quantity of wastes	Solid Wastes re-use practices	Methods currently used
Nepal Battery (Balaju)	12 million dry cells per year	Dry scraps powder (12 ton/yr) paper bags		Sold Held on-site Incineration
Nepal Distillery (Balaju)	2.6x10 ⁵ Ltrs/day	Solid		Sold
Nepal Foam Industry (Thimi)	Mattresses Pillows Cushions	Foam dust and paper 2 ton/year		Incineration
Nepal Polythene and Plastic Industry (Balaju)	1.5 x 10 ³ ton/year HDP Pipe, Household Plastic goods	Scraps		Re-used
Royal Drugs (Babarmahal)	Tablets, Ointments I. V. Fluids Capsules	Broken bottles 40 ton/yr		SWMP Tanker

Source: Dorfman and Regmi (1987) *Industrial Wastes in the Kathmandu Valley - A Cross Sectional Study*, SWMRMC, Kathmandu, Nepal. (After EMAG, 1992, Annex-28, p. 115)

A variety of refuse materials are deposited at trek campsites: food, food containers, fuel containers, ropes, tools, batteries, film, canisters, broken glass, old clothing, skies, packaging material, medicines, oxygen cylinders, cooling equipment, and utensils (Cullen 1986). The density of solid waste was found to range from 65-75 kg/m³ and the highest density was found at the Everest base camp, where the process of solid waste degradation was slowest.

Hazardous Waste

A special concern is the lack of a proper disposal system for hazardous solid wastes from industries and hospitals. Few of the industries observed disposal of solid waste in a proper way; Nepal Battery manufacturing factory practiced on site disposal and dumping on the bank of Vishnumati River. Hospitals generate hazardous and infectious wastes; these are handled through the domestic management system. Elsewhere such wastes are just dumped on open fields or discharged into public drains and rivers (Thapa, 1989).

Many industrial manufacturing processes are potential sources of toxic gases, heavy metals and complex organic compounds which may have carcinogenic effects. The analysis (EMAG 1992) has confirmed that the effluent produced during the manufacturing process contained various types of heavy metals such as chromium, zinc, lead, copper, iron etc (Table 55 p. 129 EMAG). In the effluent toxic metals (chromium, zinc and iron) were found to be at high levels not permissible to discharge in inland surface water.

The primary pollutants in vehicle emissions, particularly NO₂ and hydrocarbons, undergo a series of complex chemical reactions in presence of sun light to form secondary pollutants such as peroxyacetyl nitrate (PAN) and ozone (O₃). The quality of gasoline and diesel entering Nepal is having high lead content; and 90 per cent of Pb in urban air come from combustion of petrol in motor vehicles. The combustion elements of SO₂, NO₃, and carbon in Kathmandu are present in concentrations comparable to urban areas in industrialised countries.

CHAPTER 6

Wastes, Toxic and Hazardous Chemicals

Solid Wastes

It is estimated that around 40 per cent of the wastes generated in the towns are collected; the remainder is either dumped in the nearby rivers like the Vishnumati or left to decompose on streets and open spaces. Out of the 33 municipalities the percentage of collections are: Lalitpur 90 per cent, Kathmandu 85 per cent, Bhaktapur 67 per cent, Nepalgunj 43 per cent, Birganj 29 per cent, Pokhara 4 per cent, and, Biratnagar 2.5 per cent. The solid waste deposited on the bank of Vishnumati is made up of : i) Soil dirt 36.6 per cent, ii) Stones 35.5 per cent, iii) Bones 15.3 per cent, iv) Clothes 5.0 per cent, v) Paper Card Board etc 4.1 per cent, vi) Plastics 2.8 per cent, vii) Metals 0.9 per cent, and, viii) Glass 0.6 per cent; the total sample analysed was 436.7 Kg (*EPC, 1992 Table 2.3.14 page 60 Reorganisation of Solid Waste Disposal in the Kathmandu Valley 1982*).

The percentage of biodegradable and non-biodegradable contents observed at Kathmandu, Pokhara, and Biratnagar are almost similar: the degradable content is in the range of 76.7 to 78.5 per cent and non-degradable component varies from 21.5 to 23.3 per cent (CEDA, 1990; After EPC, 1992 Table 2.3.14, pp 60-1). The type, quantity of wastes of some of the industries in Kathmandu, their reuse practices or mode of disposal are illustrated below.

Table 14
Type and Quantity of Wastes of Some Industries

Name of Industry	Production Output	Industrial Type and quantity of wastes	Solid Wastes re-use practices	Methods currently used
Bansbari Leather and Shoe Factory	250 pairs shoes/day	Fleshing 1.5 ton/day	Split skins are sold for dog food production	Open dumping on site
		Chrome dust 200 Kg/day		Dumped with fleshing
Himalayan Brewery (Godavari)	1.5 x 10 ⁶ Ltr beer/year	Solid Wastes	Solids are used for animal feed and compost	
Himal Cement Factory (Chovar)		Solid Wastes	Solids are sold for use in roads surfacing	
Harisiddhi Brick and Tile Factory (Harishidhi)	Bricks and Tiles	Solids from clinker 800 ton/yr	Ashes are used as soil conditioner of fields	Sold
		Coal ash 400 ton/yr		Sold
Kathmandu Milk Supply scheme	2.2 x 10 ⁵ Ltr milk/year	Broken bottles and plastic	Bottles are reused	Sold
	1.1 x 10 ⁵ Kg bottles/yr	Bags 465 Kg/day		
Modern Slipper Industry (Bansbari)	6 x 10 ⁵ pairs/year	Solids (Mixture of raw materials) 1 ton/year		Untreated onto river bank

Table 14 Cont.....

Name of Industry	Production Output	Industrial Type and quantity of wastes	Solid Wastes re-use practices	Methods currently used
Nepal Battery (Balaju)	12 million dry cells per year	Dry scraps powder (12 ton/yr) paper bags		Sold Held on-site Incineration
Nepal Distillery (Balaju)	2.6x10 ⁵ Ltrs/day	Solid		Sold
Nepal Foam Industry (Thimi)	Mattresses Pillows Cushions	Foam dust and paper 2 ton/year		Incineration
Nepal Polythene and Plastic Industry (Balaju)	1.5 x 10 ³ ton/year HDP Pipe, Household Plastic goods	Scraps		Re-used
Royal Drugs (Babarmahal)	Tablets, Ointments I. V. Fluids Capsules	Broken bottles 40 ton/yr		SWMP Tanker

Source: Dorfman and Regmi (1987) *Industrial Wastes in the Kathmandu Valley - A Cross Sectional Study*, SWMRMC, Kathmandu, Nepal. (After EMAG, 1992, Annex-28, p. 115)

A variety of refuse materials are deposited at trek campsites: food, food containers, fuel containers, ropes, tools, batteries, film, canisters, broken glass, old clothing, skis, packaging material, medicines, oxygen cylinders, cooling equipment, and utensils (Cullen 1986). The density of solid waste was found to range from 65-75 kg/m³ and the highest density was found at the Everest base camp, where the process of solid waste degradation was slowest.

Hazardous Waste

A special concern is the lack of a proper disposal system for hazardous solid wastes from industries and hospitals. Few of the industries observed disposal of solid waste in a proper way; Nepal Battery manufacturing factory practiced on site disposal and dumping on the bank of Vishnumati River. Hospitals generate hazardous and infectious wastes; these are handled through the domestic management system. Elsewhere such wastes are just dumped on open fields or discharged into public drains and rivers (Thapa, 1989).

Many industrial manufacturing processes are potential sources of toxic gases, heavy metals and complex organic compounds which may have carcinogenic effects. The analysis (EMAG 1992) has confirmed that the effluent produced during the manufacturing process contained various types of heavy metals such as chromium, zinc, lead, copper, iron etc (Table 55 p. 129 EMAG). In the effluent toxic metals (chromium, zinc and iron) were found to be at high levels not permissible to discharge in inland surface water.

The primary pollutants in vehicle emissions, particularly NO₂ and hydrocarbons, undergo a series of complex chemical reactions in presence of sun light to form secondary pollutants such as peroxyacetyl nitrate (PAN) and ozone (O₃). The quality of gasoline and diesel entering Nepal is having high lead content; and 90 per cent of Pb in urban air come from combustion of petrol in motor vehicles. The combustion elements of SO₂, NO₃, and carbon in Kathmandu are present in concentrations comparable to urban areas in industrialised countries.

Many of the insecticides, herbicides and fungicides used in Nepal are toxic and persist in the food chain. Information on the nature and extent of pesticide used in Nepal is extremely limited. Sharma(1987) reported that nearly 250 types of pesticides were used, many restricted or banned in other countries. The major pesticides are parathion-methyl, carbonforan, malathion, fenitiothion, demeton-methyl, vitamax seed dressing and DDT. Since the late 1960s, the Division of Entomology has not recommended DDT for agricultural use. Bhatta, (1983) and Sharma (1987) found that seed dressing agents containing mercury were still in use. Klarman (1987) speculated that pesticide consumption by residents of the Kathmandu Valley was almost certain to be high due to the wide availability and heavy use of pesticides in the area. He noted that pesticides such as BHC and DDT which are persistent, and therefore accumulate overtime, pose a potential threat to soil, surface water and ground water quality.

Regulatory Policies and Procedures

Despite the absence of pesticide legislation and a regulatory scheme in Nepal, various regulatory controls are implemented by the Divisions of Entomology and Plant Pathology. For example, no pesticide can be imported or used unless it has been tested and approved by the Division of Entomology (in the case of insecticide) or the Division of Plant Pathology (in the case of fungicides).

CHAPTER 7

Natural Disasters

Disasters

Nepal the mountainous country, is prone to natural disasters bringing loss of life, property and productivity every year. The natural process responsible to the mountain hazards are : (a) Tectonic force, (b) Geologic formation, (c) Topography, and, (d) Nature of Monsoon or Climatic force. The Indus Tsangpo suture, represents the plate boundaries; the Main Central Thrust, the Main Boundary Fault and the Himalayan Frontal Fault separating the Siwalik with alluvium of the Indo-Gangetic frontier are the zones liable to feed the tectonic forces with earthquake manifestations. The geological formations belonging to (a) High Mountain, (b) Lesser Himalaya, (c) Mahabharat Range, (d) Siwalik Hill, and, (e) the Terai belt having different lithological composition, along with the tectonic forces upsurging periodically, develop geomorphology enshaping distinct topography and slopes; and thus evolve microclimatic belts in combination with hydrologic regime.

The existing topography expressed to dynamics of potential force seeks to narrow down periodic disequilibrium and restore stability: (a) tectonic forces activate the terrain, (b) climatic elements enhance the erosion mechanism, and, (c) human behaviour mostly promote degradation of land. The climatic stress is generated after long duration of intensive drought in the summer accompanied by heavily concentrated and scattered cloud bursts: the nature of monsoon and hydrologic regime, glacial lake outburst, landslide and consequent flood are the major components active in reactive linkages. The disasters are grouped as follows:

Flood: There are around 6,000 rivers of various lengths and four mega-basins: Mahakali, Karnali, Gandaki and Koshi. These rivers are perennial, fed by snow melt round the year. There are six smaller southern basins - Babai, West Rapti, Bagmati, Kamala, Kankai and Mechi - whose head waters originate in the middle hills and as such do not benefit from snow melt. The terai rivers originating in the southern slopes of the Siwalik are very much unpredictable and cause maximum flood damage: they become dry boulder beds during the winter while during the monsoon they become often volatile. Fluctuations can be sudden and rivers such as the Koshi have risen over nine meters in 24 hours. The Himalayan rivers transport more material from the high gradient slopes rendering terai inland delta of the rivers whose channels keep continually shifting.

The Himalayan Mountains are affected by a unique flood phenomenon called Glacial Lake Outburst Floods (GLOF). The distribution of outbursts of lake in the past is recordable (Yamada 1993). In the *Koshi basin*: (i) Phucan Glacier Lake (1980), (ii) Gelhaipco Lake outburst (1964), (iii) Ayico Lake (1968/9/70), (iv) Jinco Lake (1985), (v) Nare Drangka Glacier Lake (1977), (vi) Dig Tsho (1985), (vii) Chubung Lake (1991), (viii) Zhangzangbo Glacier Lake outburst (1964/81), (ix) Taraco Glacier Lake (1935); and in the *Gandak Basin*: (x) Longda Glacier Lake outburst (1964), (xi) Machha Puchhare Glacier Lake (450 yrs ago). In the 30 yrs since 1960, thirteen GLOFs were counted, which is a very high frequency compared to other natural hazards. It is thus surmised that GLOF in Nepal Himalayas took place more than once every three years.

Dangerous glaciers lakes observed in Nepal Himalayas. (Yamada 1993)

Barun Khola Drainage Basin: 1. Lower Barun Glacier; *Dudha Koshi Drainage Basin*: 2. Chamlang Tsho and three nameless glacier lakes, 3. Glacier lake formed in front of Naulekh Glacier, 4. Sabai Tsho, 5.

Dudh Kund, 6. Mojang Glacier Lake, and, 7. Imja Glacier Lake. *Tama Khola drainage basins*: 8. Tsho Rolpa (Tramban Glacier); Marsyangdi Khola drainage: 9. Thulagi Glacier Lake. GLOF occurs when the moraine dam becomes unstable and breaks due to heavy glacial melt or rain; natural tunnelling of the moraine wall, or a sudden ice avalanche are the usual events. The rocks and debris are released into the valleys below with such intensity that the base of the valley is badly fractured and eroded, and becomes extremely unstable. This results in numerous landslides and, thus increases the destructive potential of a GLOF. The extent of flood damage depends on the speed of the release of the impounded glacier waters. If it is gradual, the effect may not be as devastating; on the contrary, in sudden releases, the damage caused by the cascading water and associated debris can be catastrophic. Floods in the terai occur regularly and cause considerable damage; and the people are also better prepared to cope with the situation. Floods, heavy rains and landslides in 1985/86 caused 313 deaths, 122 injuries, a loss of 1853 cattle, 3574 houses and 18 bridges, and 15,523 ropanis of land (in the hills) and 16,505 bighas of land (in the terai) were affected in varying degrees; thus the total loss amounted to US\$ 3.96 million (SAARC Regional Study 1992). Flood loss recorded is given below for the durations 1983-1990.

Table 15
Summary Record of Floods in Nepal (1983-1990)

Year	Dead	Injured	House Destroyed	Families Affected	Land Affected (in ha.)	Livestock Loss	Infrastructure	Property Destroyed (in M. Rs)
1983	293	0	na	na	0	248	0	240.00
1984	263	na	7566	na	12418	3114	869	37.00
1985	420	0	4620	na	13544	3058	173	58.10
1986	315	0	3035	na	13158	1886	436	15.85
1987	391	162	33721	96151	188579	1434	421	20,000.00
1988	328	198	2396	4113	0	530	0	10,873.10
1989	60	0	6024	na	0	1512	0	2504.84
1990	307	26	3060	5165	1131.33	314	na	53.00

- Note : 1. All units are numbers, unless otherwise indicated in the column heading.
2. Infrastructure indicates damage to public infrastructures (e.g. bridges, roads, etc.)
3. na indicates information not available.

Source : Ministry of Home Affairs (After EPC, 1992, Table 2.3.12 p. 54)

Drought: There is deficiency of information on dry land issues. Drought conditions have been known to prevail in the Far Western Development Region of Nepal where rainfall is insufficient as the monsoon arrives 2/3 weeks after it reaches the eastern border of the country. Drought like conditions have sometimes prevailed in all parts of the terai because of insufficient irrigation systems. A major factor aggravating the natural dry spells in Nepal is the low level of surface irrigation. A maximum of 36 per cent irrigation is provided in the pre-monsoon season.

Command area schemes meet only 30 per cent of the irrigation needs; irrigated areas are classified as those that are able to meet 50 per cent of their total irrigation needs; and 50 to 95 per cent of the cultivated land is unirrigated under surface flow systems. The extent of irrigated land under ground water programme is considerably limited; and the reliance of agricultural lands on the monsoon is crucial. Delay in monsoon or inadequate precipitation can cause extensive drought-like conditions. Floods and droughts can occur in the same year and in the same location. The fact is not being seriously noted that the water surplus area can suffer from severe water scarcities when ecological aspects are not being taken into account. Hill farmers are particularly sensitive to water scarcity, and

have autonomously developed appropriate water harvesting technologies. However, no effort has been made to assess the effect of river diversion on fragile micro-ecosystems.

Mass Wasting and Landslides

It is being considered that 30 per cent of the world's landslides occur in the Himalaya; and it is the major natural disaster in Nepal. A survey recently discovered that 78 major landslides occurred annually in the central and western development regions between 1970 and 1980. The average annual loss based on the official cost of land and cattle was Rs.6.5 million; this does not include the loss of production and the cost of rehabilitation and human suffering. If the other three regions and remote areas of Nepal were also taken into account, the costs of landslides to the country's economy could be incalculable.

The intensity of rainfall, stone quarrying, dam construction etc. aggravate landslides; cloudbursts occur regularly during the monsoon months; rainfall of over 300 mm can fall in a single day. In 1978, 125 mm of rainfall fell within a few hours in the Tinau watershed; a landslide then blocked the river; the subsequent overtopping of the natural dam wiped away Dauretole of Butwal causing colossal damage to life and property. Landslides caused by flash floods often temporarily dam rivers, which burst releasing an even more intense flood that lead to even larger landslides and mass wasting by severe undercutting of toes of ridges which form the river banks.

Geological conditions in the fractured hills of Nepal are area-specific; they vary in terms of the type of rock and debris, dip of rocks, slopes and extent of ground water seepage; and all these result considerable variance in the levels of vulnerability to landslides, rock slides, and soil creep. These instabilities are aggravated by seismic disturbances, and take many years to stabilise. A major landslide in Gumba village (Sindhupalchowk) has been active for the last 40 years and has shown no signs of stabilising; and, it has consumed several villages. In the northern reaches of the middle hills, especially in the vicinity of the Main Central Thrust where seismic influences are more pronounced, rock structures are generally weaker and rock slides frequent. Failures of Chisang Khola Hydro-electric establishment, Chapakot Tar Irrigation Project, and Pardi Dam of Pokhara do indicate the need of considering geological factors towards minimising instabilities.

Earthquakes

The Indian sub-continent situated on the boundaries of two continental plates is very much prone to earthquakes. Nepal lying on the southern slopes of the Himalaya is subject to high seismic activity. A chronology of earthquakes of magnitude six and above on the Richter scale indicates that between 1800 and 1975 A.D., 23 major earthquakes have occurred in Nepal. Observations suggest that large earthquakes occur about once in 50 years; but there have been three major earthquakes in the last 55 years. The 1934 earthquake which affected Bihar and Nepal destroyed 3,400 lives in Kathmandu valley alone. In 1980 Bajhang was struck by a powerful earthquake in which there was heavy loss of life and property. In 1988 an earthquake of magnitude 6.6 on the Richter scale, with its *epicenter* at Udaipur in eastern Nepal, killed 717 people and destroyed several thousand houses. Besides the two major thrusts, there are many longitudinal faults which divide the Himalaya into blocks from East to West. The epicenter of major earthquakes are often located along these fault lines.

Following the study of the consequences of Udaipur 1988 earthquake which is deemed to be of a moderate category the losses were of the following magnitude: (i) injuries 6,463 people (1,629 were injured seriously), (ii) buildings damaged 63,003 in number; 21,832 were totally destroyed; and, (iii) cattle killed 1,483. Damage to ordinary buildings and structures was far more than to RCC structures which appeared to have withstood the shocks more effectively. Ground fissuring was prominent. Landslides in the Churia and Mahabharat Ranges affected an area of 0.62 million hectare. These had serious consequences towards the stability of irrigation canals, and roads and trails.

Part

Causes and Consequences

CHAPTER 8

Poverty and the Environment

Marginalisation of Agriculture

Land is most important resource in Nepal because over 90 per cent of the population remains dependent on agriculture and related activities for its livelihood; one fifth of the total land is cultivated; and fragmentation of already minuscule holdings has resulted in increasing marginalisation of agriculture. The dominance of agriculture as the major source of income and livelihood directly relates it to income distribution. Half of the about 2.2 million farms in the country are less than 0.5 ha in size, the average land holding being 0.15 ha and this too undergoes an average of three fragmentations. On the other hand 16.1 per cent of the farmers own 62.8 per cent of the land and the proportion of landless household had progressively increased to 20 per cent by 1981/82.

The poor performance of the agricultural sector is a major factor in contributing to increasing poverty in Nepal. Grain production increased at the rate of 1.5 per cent during the period 1975/76 to 1985/86 with productivity falling by 0.5 per cent and population recording a growth of 2.6 per cent. Per capita production thus fell from 92 per cent of requirements in 1976 to 80-85 per cent in 1988.

Poverty Line

As per Eighth Plan 49 per cent of the country's population is below the poverty line. The NPC estimated a poverty line income of Rs 1,971 (US\$110) per person per annum at 1984/85 prices, basing it on minimum caloric requirement. In view of the NPC estimate 40-60 per cent of the country's population live at levels below minimum caloric intake, with 97 per cent of the absolute poor living in rural areas. It is being deemed that the majority of the population living in the hills and mountains and a quarter of the terai population fall below the poverty line.

Income of Bottom 40 Per cent

The average monthly income in urban areas is Rs 1,785 against Rs. 1,192 in rural areas (1984/85). The NPC (1976/77) showed that the bottom 40 per cent of households in the country received only 8.7 per cent of the income whereas the rest of the top 10 per cent was 46.8 per cent.

Asian Regional Team for Employment Promotion (ARTEP 1973) found that the bottom 40 per cent shared 13.9 per cent and 10.7 per cent of the Hills and Terai income respectively. The top 10 per cent on the other hand received 32.1 per cent and 38.5 per cent of incomes in the terai and hills respectively. The relatively high Gini coefficient of 0.59 in the NPC survey, and 0.57 in the Nepal Rastra Bank survey (1987) are quite matching; and 0.43 (hills) and 0.51 (terai) recorded in the ARTEP study indicate the incidence of inequality between the two groups. It has been recorded (UNCED-92 National report Nepal p.28) that in the per capita income distribution the bottom 40 per cent and the top 10 per cent receive each 23 per cent, and the middle 50 per cent receive 54 per cent.

Environmental Degradation

(i) *Soil Loss from terraces*

In Nepal, the Siwaliks and Middle Mountain belts are more susceptible to erosion; the former has erodible soil and poor geological formation while the latter has high population pressure with limited productive land. Current farming systems, though there is general lack of data, exploit the resources considerably. Laban (1978), Gilmour (1983) and Ramsay (1986) have recorded erosion data in the hills but these are too sporadic to be generalised. Soil loss from terraces varies enormously; canal failures on irrigation schemes is common leading to gully erosion; surface soil loss on rain-fed cultivated lands leads to deterioration of physical and chemical properties towards lowering productivity, enhancing erosion and loss of nutrients.

(ii) *Decline in soil fertility*

A rough estimate of surface soil loss in the Mountains/Hill ranges from 5-10 tons/ha/yr in well managed land to 40-200 ton/ha/yr in degraded land. Cultivation on sloping land causes high nutrient loss and as a result land degradation is severe. Uneven and inappropriate use of chemical fertiliser without understanding soil fertility status, nutrient availability and crop requirement has as well been contributive to the decline in soil fertility. Loss of soil fertility mainly affects rain-fed areas; inadequate compost preparations may lead to degradation of soil; and land may be abandoned temporarily or permanently. About 20 per cent of the cattle population are unproductive; uncontrolled grazing of abandoned land leads to site degradation by trampling and suppression of vegetation by soil compaction; this results in excessive run off and gully formations expanding laterally or headward.

(iii) *Degradation of Forest*

Over exploitation of forest resources is demonstrated by the reduction in Crown cover; in the middle mountain 48 to 60 per cent of forest cover lies in density class 10-40 per cent; and a high proportion of forest is immature (WECS, 1986; ERL 1988 p. A125). Public forest are a major source of fuel; and there is a greater demand on the diminishing resource of the middle mountain. Unquantifiable but serious causes of degradation of the forest resource include: (1) heavy lopping of trees for fodder; (2) destruction of young seedlings and coppice growth by grazing livestock; (3) set back to regeneration following firing of forest litter/ grassland; (4) removal of forest litter for compost and bedding for livestock to an considerable extent; (5) heavy and seasonal use of fuelwood for brick kiln; and, (6) use of fuel wood for crop drying. About 22,700 ha of the total forest areas were cleared during 1979-1985; and an equal area of forest could have been lost due to illegal settlement during the same period.

(iv) *Overgrazed pasture*

Grassland cover 279,600 Ha (6.3 per cent) in the middle mountains; almost all are extensively grazed; invasions of non-edible species (*Empatorium*, ferns) is common; these species reduce the fodder production but may be beneficial in checking soil erosion; and surface erosion of 5-6 mm per year has been recorded on overgrazed pasture in Phewatal (Ramsay 1986).

Long-term data on hydrology or sediment load is lacking. Sediment production varies even within the same phsiographic region. The source of sediment production is primarily mass wasting which is mostly geologically controlled (WECS. 1987). Sediment load of local level is strongly influenced by human activity; variable natural factors dominate stream discharge and sediment load at the medium

level; and while looking in large basins human impacts in the upper watershed do not indicate significant effect on lowland floods, low flow and sediment (Hamilton 1987). Although no systematic information on slope failure due to construction activities have been collected, some studies do suggest that 5 per cent of landslides were associated with roads and trails and some of the farmer built irrigation canals have been found to induce mass wasting.

(v) *Pressure on resource base*

The state of the Hills' Natural Resource Base indicates that there is a growing crisis in terms of the population's dependence on natural resource products for their subsistence in terms of fuelwood, fodder and food; and village households are already responding to the increasing reality of shortages in certain products in local areas in a number of ways (ERL, 1989 Box 1.2 (a) and 1.2 (b) pp 3-5).

In reviewing pressure on the resource base we may look to the following:

- (i) *Components of demand:* These are made up of food, fodder and fuelwood. The level of food consumption is only 70 per cent of Basic Needs target level and there is little opportunity for reducing levels. The demand for fodder is a function of the number and type of animals kept in the Hills and it was the poorest farmers who created the greatest pastures on the common lands. The demand for fuelwood comes from domestic needs and from off-farm activities, and the pressures on common forest land are greatest from the poorest households which do not have sufficient private land for tree plantation. The result of these pressures is an upward spiral in per capita demand which amplifies the effect of population growth.
- (ii) *Managing supply to meet demand:* There are physical limits to available land and productivity of these lands is low for a number of reasons. The supply of good agricultural land is limited; only 5 per cent of the hills land is considered good agricultural land, while 38 per cent requires terracing; and the remaining is only suitable for forestry or is just rock and snow. Forest and grasslands have been poorly managed. The private agricultural holdings in the hills are very small and fragmented requiring intensive farming to meet per capita demand. Inputs such as chemical fertilisers, improved varieties of livestock and irrigation are financially beyond poor farmer's reach and hard to have access to. These factors cause a downward cycle in the ability of both public and private lands to meet demand.
- (iii) *Socio-economic cause affecting demand and supply:* On the demand side population growth is the key consideration. The out-migration is the response to the inability of hill farming households to live even at subsistence level in the hills. The low incomes of the majority of Hills households limit their ability to use substitutes from outside the hills. Poor transport to the hills makes it difficult for those who can afford to use kerosene or import food to obtain substitutes. On the supply side, property rights to forest and grazing lands are vested in the government. Resource management actions taken by the government, such as Community Forest Programme cover only 1 per cent of national forest.
- (iv) *External causes:* Natural resource based tourism is concentrated in the hills; trekking and mountaineering create additional demands for fuelwood in areas having limited ability to meet demand; and construction of roads and hydroelectric schemes may affect specific areas either through loss of productive land and degradation of natural resources. (ERL 1989 Figs. 1.3 (a) and 1.3 (b) pp. 7-8).

CHAPTER 9 Population and Lifestyle

Concentration to the Terai

Traditionally Nepalese hills has been the zone of population concentration; after the eradication of malaria the terai zone opened up thus gradually building up the concentration to the terai. The population has doubled up during 1920 to 1971: from 5.5 to 11.5 million; during 1952-1981: from 8.2 to 15.0 million; during 1961 to 1991 from 9.4 to 18.4 million; and is projected to the magnitude of 30 to 32 million in 2010 almost double of 15.0 million of 1981. The rate of growth increased steadily in each intercensal period from the initial rate of 1.65 per cent per annum to 2.66 per cent per annum in 1981.

The population Pressure Index (PPI) for the decade 1961-71 indicates that 47 out of 75 districts and 34 out of 36 hill districts fall into the over-populated category. The 1981 census shows a close relationship between PPI (1971) and out-migration of the hill region (1981). (See ERL, 1988, p. A42).

Table 16
Distribution of Population in Percentage

Geographical Division of Nepal	Area (in %)	1920	1952/54	1961	1971	1981	1991
Himal Hill	35.2 %	-	-	-	9.9	8.7	7.3
	41.7 %	-	-	-	52.5	47.7	46.1
		61.9	64.8	63.6	62.4	56.4	53.4
Terai	23.1	38.1	35.2	36.4	37.6	43.6	46.6
Total	1,47,181 km ² (100)	5.57 million	8.26 million	9.41 million	11.55 million	15.02 million	18.46 million

Table 17
Annual Increment of Population in Percentage

Geographical Division	1971-81 decade	1981-1991 decade
Himal	1.35	1.04
Hill	1.66	1.62
Terai	4.20	2.76
Nepal	2.66	2.08

Demographic Trend

Rapid population growth has become the main constraint to development. The momentum of growth has remained unchecked. About 40 per cent of the total population is below 15 years with the median age at 19.9 years. This signifies a great potential for rapid growth in the ensuing years. Current efforts to combat population growth will have some impact only by the year 2030. In Nepal today 4.1 million girls are approaching reproductive age, a figure which is 50 per cent higher than all women currently fertile. Population dynamics indicate that although efforts at curbing fertility and growth will have no impact during this generation, the next generation will benefit tremendously from the initiative that are being taken now.

Food Balance

The balance between food production and population has deteriorated in the hills as indicated by estimates based on cropped area, physical output and population. A majority of districts in the hills areas are of chronic food deficit in relation to FAO recommended minimum requirements (ERL 1988, p.A42). Various sources (Macfarlane, 1976; CBS 1987) indicate that the principle factors driving out-migration from the hills are: (i) Shortage of land, (ii) Shortage of food, and, (iii) Lack of employment opportunities. A large proportion of households in the hill and mountain district cannot survive on the basis of what they produce themselves. The typical hills household can only grow two-thirds of its annual food requirement; and 49 per cent of households are below the poverty line (Conlin and Falk 1979; National Planning Commission 1992). The 1981 census provides: internal migrants from the mountain (to the hills and terai) was 195,644 and from the hills (to the terai) 214,917. Calculation (ERL 1988 p.A6 Table 1.3.2 (a) reveals that (i) the terai was the net recipient of almost 400,000 internal migrants during 1970-81, (ii) the dominant pattern of rural migrant from north to south, from highland to lowland, (iii) a higher volume of migration (north to south) in the east and central regions of Nepal than in the western regions - thus limiting further opportunities of migration in the eastern and central terai in absence of agricultural intensification programme. Estimates have been made that urban areas (33 towns) observed about 260,000 migrants (equivalent to 40 per cent of total urban populations growth) from rural areas of Nepal and from outside Nepal in the period 1971-81; of these 50,000 came from the rural hills (ERL 1989, p. A8).

Population growth has severe effect on food balance. Assuming an annual food requirement of 195 Kg per person a deficit of 498,000 MT by 1995 will affect about 2.55 million people or just about 12 per cent of the total population; by 2010 about 6.2 million or 20 per cent would be affected. The severity of the food deficit will be accentuated by the growing unemployment and under-employment. Traditionally it has been difficult to divert food grains from food surplus region to deficit region because of logistic constraints.

Data on international net migration are unreliable; estimates based on the Population Commission come to the order of 500,000 net international immigration for the period 1971-81. The competition for land in the terai has an international dimension; international migration is acting as a means of reducing population pressure in the hills and about 200,000 people emigrated from the hills (ERL 1989, Table 1.3.2 (c) p.A10).

Short-term Migration

The pattern of short term migration vary greatly:

- (1) Seasonal migration by hill people for employment or trade in the terai towns and India during the slack agricultural season: November to March.
- (2) Migration for trade largely concerns specific ethnic groups (Sherpa, Thakalis, etc). Kin and friendship links are also important in securing employment in low -land areas.
- (3) In Doti (1968) nearly a third of households had at least one member who seasonally migrated to the neighbouring terai districts (60 per cent) or India (40 per cent). Among the poorest groups, the whole family may migrate, with women working in paddy husking and men in construction (New Era 1984).

- (4) Thabang (Molnor 1981) - A Kham Magar Village in the western hills (Rapti Zone, Rolpa District) - illustrates the variation of short-term migrations by type of activity, income level and gender. They work on potato farms in Simla (India); some are in army - 31 per cent of Thabang households have one member in active service. It is mainly men who migrate; they spend almost half their time away. For men of all economic strata herding is the predominant migratory activity. Army service and trade are also significant for men of the highest income group. Herding and visits to relations account for over 90 per cent of female time away from the village (ERL 1989, p. A12).

Sources of Non-Agricultural Incomes

Around 95 per cent of the people living in the rural hills are primarily dependent upon agriculture for their livelihoods; while agricultural production is largely subsistence in nature, cash incomes contribute 41 per cent (hill) and 39 per cent (terai) of the average rural household's budget (Nepal Rastra Bank 1988).

An average hills household can only grow enough food on their land holding to provide two thirds of their annual cereal requirements in a normal year; and they need to supplement their income in some way even by resorting to marginal lands. The reason for needing cash income are: (i) payment of rent and interest, (ii) capital investment and improvement, (iii) Education, (iv) religious and social ceremonies, and, (v) purchases of imported goods-salt, kerosene etc.

Sources of non-agricultural incomes vary considerably on eight sample villages and there is a wide range of significance for activities within the categories of food processing and manufacturing (ERL 1989, p. A14; Table 1.3.3(a) and 1.3.3. (b). Acharya and Bennett analyse the time spent by women and men respectively on non-agricultural activities. They find that women typically spend 20-50 per cent more time on these Hill households. Searches of available data reveal principal sources of incomes for rural hill households as: (i) remittances from migrants, (ii) cottage and small industries, (iii) infrastructure constructions, (iv) trading , and, (v) tourism.

State of Unemployment

Under-employment is notable in the hilly region - 65 per cent of household labour days are under-utilised; off-farm work activity accounts only for 15 per cent of household labour days; small farmers and the landless provide most of the off-farm labour using 24 per cent of the total available yearly labour days. Under-employment seems to be almost equal in all the development regions not varying by more than 7 per cent from the highest (East 66.6 per cent) to lowest (West 59.1 per cent). Regarding income distribution 40 per cent of the poorest household obtain 10.7 to 13.9 per cent of the total income in terai and hill respectively. With the lack of significant manufacturing and industrial employment opportunities in the hills, those needing work have to depend on infrastructure and reafforestation activities, as well as small scale and cottage industries. (ERL 1988, p.A44).

The number of people employed by construction projects during the Sixth Plan period has been estimated about 40,000 equivalent full-time jobs in the hills. The number of hills people involved in full-time and part-time portering and trading has been estimated at about 500,000. The number of hills people directly employed by the tourist industry (i.e. as guides and parks employees) has been estimated as 4,500; though to this should be added those employed in lodges, tea houses etc. The estimated current earnings rates vary between NRs.10 and 100 per day of full time work. (ERL 1989, p.A16, Table 1.3.3(d)).

The state of un-employment and under-employment will become more serious as the labour force swells with rapid increase in the population and labour force participation rate. Between 1990-2000 the labour force is estimated to increase at the rate of 2.7 per cent per annum, and by 2010 each year 290,000 will be entering the labour market. (EMAG, 1992, pp. 33-4). With the increase in population, density on cultivated land will also increase from 8 persons/ha in 1985/86 to more than 9.5 persons/ha by 2000 A.D.

CHAPTER 10

Urbanisation

Strategic Locations

Over the period of the 17th to 19th centuries a number of garrison towns emerged at strategic locations throughout Nepal in response to the need of the state to exercise control over newly annexed territories. Newars from and around Kathmandu were encouraged to migrate to these towns located at the midland hills and valleys such as Silguri-Doti, Dailekh, Pyuthan, Tansen, Pokhara, Bandipur, Bhojpur, Dhankuta etc. Recruitment of the Gurkha soldiers in the British Army and need of timber for railway coaches of Indo-Gangetic plain brought extensions of Indian Railways along the border with India; there was thus rapid exploitation of rich terai forest and trade links between mid-hill towns and Indian cities began to flourish giving rise to emergence of small trading ports such as Dhangadhi, Nepalganj, Bhairahawa, Birganj and Biratnagar along the terai border.

New Horizon

With the eradication of Malaria in the late 1950s, resettlement schemes such as the Rapti Valley Development Project (1954) and later the construction of East-West highway initiated migration of hill population to the terai belt towards easing the land pressure in the hills and in developing important feature of national development in the new horizon. In pursuit of achieving required balance regional directorates were established from the duration beginning Fifth Plan onwards; and placement of civil servants spread over all the districts, regional center and in the emerging towns; thus public sector became one of the primary source of employment in the urban centers absorbing some percentages of economically active population.

Location Advantage

The 1952/54 census registered 10 settlements having population of 5,000 or more; the 1961 census for the first time defined "urban" as those settlements having 5,000 or more population and with urban facilities such as markets, industrial establishments, schools, offices, industries etc; and 16 settlements were identified as towns. The 1981 census recorded 23 towns and by 1987 the total number of towns stands at 33; of these only 8 are in the hills, 18 are in the terai. 4 in the inner terai, and 3 in the Kathmandu Valley. The mountain regions have no urban population. With the inclusion of Tulsipur, Damauli (Vyas), and Gaur as Municipal areas recently, there are at present 36 municipal areas in the country. Location advantages have determined the growth of urban areas. The growth was originally concentrated in the Kathmandu region, but the locus has shifted to the terai, particularly to the eastern terai. In 1981 the terai accounted for 53 per cent of the urban population, compared to 17 per cent in 1952. The location triangle of Biratnagar, Kathmandu and Birganj encompassed the locations of the major industrial enterprises of Nepal. In 1981, 52 of the 64 medium and large scale industries were concentrated in this area, mostly on the vertex and edges of the locational triangle defined by these cities.

Urban Growth

The picture of regional urbanisation reveals Kathmandu having urbanisation level of 54 per cent in 1991; and an average annual growth rate of 5 per cent during 1981-91 (Sharma 1993, Table 1&2). Urban growth by location analysed by Sharma (1993) indicates decline in growth rate in some of the

terai/inner terai/ urban centres such as Birganj, Biratnagar, Dharan, Siddhartanagar, Janakpur and Hetauda while comparing between the two decade 1971-81 and 1981-91; on the other hand Pokhara, Bharatpur and Kathmandu have been singled out as the three fastest growing towns of Nepal.

Data of the past three decades (1961-1991) shows that the proportions of populations living in urban areas increase with the size of the urban centre: (i) Cities over 100,000 populations had 39 per cent of the total urban population compared to about 25 per cent in 1981; and, (ii) Large towns over 50,000 population had 31 per cent compared to 18 per cent in 1981 (Table 3: Sharma 1993). Similar to primary gateway towns along the Terai border in the seventies secondary gateway towns along the foot hill show growth rates in excess of 4 per cent in the eighties.

Migration has been a substantial impact to urban growth in Nepal; growth rates since 1971 indicate 52 per cent of the increase in urban population was caused by migration and reclassifications; and this rate rose up to 55 per cent during 1981-91 (Sharma 1993). The opportunities of employment have attracted migrants; and recent evidence (1991 census) suggest that the tempo of Hill to Terai migration may have somewhat declined due to rush to urban centres.

Dismal State

The dismal state of urban infrastructure are illustrated (in fig 2, Sharma 1993): (i) situation with respect to sanitation, shows serious deficiencies; (ii) storm water drainage does not exist in any of the towns; (iii) modern solid waste collection system has been partially implemented in Kathmandu; (iv) about 25 per cent of the total road mileage in urban areas is in good condition; (v) water supply in most towns is intermittent and is not sufficient and safe; (vi) electricity supply is subject to frequent unscheduled interruption and voltage instability is common; and the pressure on the existing infrastructure is already high in most major urban centres. Environmental pollution resulting from untreated sewage disposal in natural drainage systems, traffic noise and emissions from vehicles and industries are increasing in serious magnitude.

Major Trends

Emerging trends in urbanisation indicate that the Kathmandu Valley, Terai and Inner Terai region, and Pokhara (among the hill town) will increasingly experience urban development in the future. The reasons may be looked into as: (i) pressure of population in rural areas in general, and rural hills and mountains in particular; (ii) declining productivity and degradation of land resources; (iii) reduced scope for land based migration to the terai; (iv) increased literacy and search for off-farm employment opportunities; (v) concentrations of infrastructural investments, institutional setting and increase in employment opportunities in urban area. Urban growth in the hills will remain continued on the extent to which productivity enhancements in agriculture can be brought forth to facilitate transaction, processing, and expansion in off-farm employment opportunities.

Urban population of Nepal by the year 2002 has been projected: (i) 33 municipalities would be nearing 3.2 million population; (ii) Kathmandu will have close to 600,000 people; (iii) nine towns (Biratnagar, Lalitpur, Dharan, Hetauda, Janakpur, Birganj, Pokhara, Siddhartha Nagar and Nepalganj will have population more than 100,000 each (MSUD 1989, Sharma 1993, p.120); and by 2010 close to 7 million people will be in Nepalese urban areas requiring generation of 100,000 new jobs in urban sector each year (Banskota et al 1990).

ERL (1989) Observes: (i) Non-agricultural incomes in the rural hills are limited; and number of jobs under cottage and small industries created could be less than 100,000 over the period 2010 emphasizing activity specialisation and locational concentration; (ii) Out-migration from the rural Hills of Nepal can contribute greatly to relieving the ever increasing degradation of the hill resource base; this will still only reduce, not resolve, the problems of degradation in the rural hills of Nepal; (iii) migration to towns may absorb between 2 and 5 million additional people in the period to 2010; and efforts may be made to absorb some in places with proven locational advantage specially at nodal points along the east-west highways.

CHAPTER 11

Agriculture and Fisheries

Projected Deficits

The economy of Nepal is dominated by agricultural sector. It has a 54 per cent share of GDP and accounts for 75 per cent of the total exports. Over 90 per cent of the economically active population depends on this sector for subsistence living. The total cultivated area and non-cultivated inclusions are 3 and 1 million hectares respectively; out of that middle mountain has 40 per cent of cultivated land and 67 per cent of non-cultivated inclusions. Taking population figures as 18.5, 24.0 and 31.0 million for the years 1990, 2000 and 2010 the food deficits projected are in the magnitude of over 0.4, 0.6 and 1.2 million metric tons for corresponding years.

Agro-climatic Zones

Though ecological division of (i) High Himal, (ii) High Mountain, (iii) Middle Mountain, (iv) Siwalik, and, (v) the Terai have been retained in reference; but for simplicity the three physiographic divisions: (a) Mountain, (b) Hill, and, (c) Terai, are much more practical for citing examples. Agro-climatic zones have been established (APROSC, 1990) under (1) Sub-tropical and (2) Temperate regime: the divisions of sub-tropical are : (1a) Moderately dry, (1b) Sub-humid, and, (1c) Moderately humid; and the divisions of the temperate regime provided are: (2a) Sub-humid, (2b) Moderately humid, (2c) Humid, (2d) Per-humid (Map p.191, EPC 1992).

Cropped Area and Productivity

The area coverages by the crops (190/91) are 3.1 million ha: and the occupance by various crops are: (i) Paddy 46.7 per cent, ii) Maize 24.3 per cent, iii) Wheat 19 per cent, iv) Millet 6.4 per cent, and, v) Potatoes 2.7 per cent. The production (1990/91) has been 6.6 million MT; and the inputs calculated in percentages are: i) Paddy 53.3 per cent, ii) Maize 18.7 per cent, iii) Wheat 12.7 per cent, iv) Potatoes 11.2 per cent, and, v) Millet 3.5 per cent. In the mountain millet, barley and potatoes are recordable both in area coverage and productivity. In the hills area coverages are pronounced for maize, wheat, millet, barley and potatoes; whereas the productivity of millet is to be underlined. The terai plain is quite productive and except millet (which is the crop of the hill) productivity of all the crops are quite notable; and in area coverages paddy and wheat are cultivated extensively.

Table 18
Distribution of Cropped Area in Percentage 1990/91

S.No.	Crops	Mountain	Hill	Terai	Total Cropped Area (Area in '000 ha)
1.	Paddy	2.74	23.78	73.47	1455.17 (100)
2.	Maize	7.73	70.91	21.36	757.71 (100)
3.	Wheat	7.12	40.87	52.00	592.74 (100)
4.	Millet	12.63	80.96	6.40	198.57 (100)
5.	Barley	36.57	51.97	11.45	
6.	Oil seeds	1.02	18.92	80.05	156.31 (100)
7.	Suger cane	0.30	7.55	92.15	32.96 (100)
8.	Potatoes	23.13	55.24	21.63	84.24 (100)
9.	Tobacco	-	1.92	98.08	7.29 (100)

Source : IUCN (Prof. Malla's compilations)

Table 19
Crop Productivity 1990/91

S.No	Crops	(Productivity MT/ha)			Nepal	
		Mountain	Hill	Terai	Production (Production in '000 MT)	Productivity
1.	Paddy	2.109	2.378	2.427	3502.16	2.406
2.	Maize	1.508	1.575	1.831	1230.95	1.624
3.	Wheat	1.063	1.242	1.589	835.97	1.410
4.	Millet	1.106	1.181	1.095	231.63	1.166
5.	Barley	0.937	0.936	0.967	27.84	0.940
6.	Oil seeds	0.689	0.650	0.573	92.14	0.589
7.	Suger cane	14.900	16.461	35.017	1105.96	33.554
8.	Potatoes	7.624	7.949	12.028	738.03	8.756
9.	Tobacco	-	0.714	0.962	6.98	0.957

Source : IUCN (Prof. Malla's compilations)

Deteriorating Situation

The basic data on production and yields for the duration 1972-86 (DFAMS, 1985; ERL 1988, p. B37/38) shows decline in the yields of all crops; the declines over the whole period range from 2 per cent for wheat to 48 per cent for paddy. This is one of the key features of hill agriculture that is indicative of a deteriorating situation. It is at variance with that of the terai region of Nepal. A number of reasons have been advanced for this decline in productivity: (i) marginal land of lower productivity has been brought into cultivation during the past 20 years 1971-1991; the highest area increases on marginal farming have been noticed in the hills region (46 per cent) and is followed by mountain regions by 38.4 per cent. (Chitrakar, P.L. 1990: DFAMS 1991); (ii) decline in quality of compost and availability of compost - and this is not being supplemented by the increased use of chemical fertilizer; (iii) Loss of soil fertility through erosion - this is to be understood in context of WECS 1987 studies (for the duration 1964/5-1978/9) estimating that average annual rate of forest disappearance for the hill to be 0.2 per cent for forest area and 2.1 per cent for forest cover (because of conversion of forest to scrub land, scrub-land to open grazing land, and open grazing land to terrace)- (ERL 1988, p. A18); and (iv) Hill land under irrigation remains uncertain but it is unlikely to exceed 10 per cent.

The state of agriculture in the hills is the carrying capacity of the current production methods. Assuming that each individual needs 210 kg of food grains per year (the international WHO standard basis), only a handful of hill districts are self-sufficient on that basis. The current estimates are:

Region	Per cent of population that can be fed at WHO International Standard
Eastern Hills	103 %
Central Hills	70 %
Western Hills	75 %
Mid-Western Hills	77 %
Total	77 %

N.B. : Food grain only accounts for 87% of total intake.

Source: Long Term Food Plan, 1985-2005 APROSC (1986 after ERL 1988, p.B4).

Deficits of TDN

In economic terms livestock is a source of cash income and a store of wealth and a hedge against inflation. Some farmers are holding more animals per household to compensate for reduced productivity. And the fall in productivity is primarily a result of less feed available for animals. It is estimated (ADB Agricultural Sector Study 1982; ERL 1988, p.B5) that the hill ruminant livestock require 4.85 million tons of Total Digestible Nutrient (TDN) per year. Of this about one million MT come from crop residues, and 0.35 million MT come from fallow land grazing and crop thinning and weeding. This leaves a balance of 72 per cent that has to come from non-farm sources: i) 35 per cent from rangeland, ii) 23 per cent from forest, and, iii) 14 per cent from marginal land. The region's capacity to feed its livestock has been studied by Rapti Zone Livestock Development Assessment (HMG/Nepal/USAID, 1986; ERL 1988, Table A. 2.4. (b) p. B5); there is 55 per cent deficit of TDN, a 41 per cent deficit of dry matter and a 68 per cent deficit of crude proteins in the middle mountain; and the deficits for Nepal as a whole are 31 per cent, 9 per cent and 52 per cent for the same categories respectively. Hence the situation is substantially worse in the hill than in any other region of the country.

Land Holdings

National Farm Management Study (DFAMS, 1986) and Khardep Study (Conlin and Falk, 1979) have based their observations on three land holding size categories: I. (0-0.5 ha), II. (0.51-1.0 ha), and III. (1.01+). Farmers below 0.5 ha are completely subsistence oriented; adult members are forced to take off-farm work, annual seasonal migration; and, cropping intensities tend to be high (170 per cent). Farms between 0.51-1.0 ha are likely to be cereal deficit households and are vulnerable to the vagaries of the weather; and off-farm income is still needed to supplement food supply. Farms 1.01 ha or larger have a higher proportion of *Khet land* in addition to highest absolute area; landowners in this category often provide employment to individuals from the smallest category of holding to assist in planting and harvesting of their crops. These farms, on average, are just self-sufficient, although in a climatically poor year these may also be unable to produce enough cereals for their needs. Farm with larger holdings can produce surplus grain. Compost applications on larger farms are very low (Conlin and Falk, 1979; ERL 1988, Table 1.4 (c) p.A63). It has been noted that 20 per cent of the farmers in the three Koshi hill districts cultivate 3.7 per cent of land; and, 79 per cent of all farmers farmed less than a hectare. Similarly of the households from the nine Hill Districts (Sindhuli, Nuwakot, Tanahu, Ilam, Gulmi, Salyan, Baitadi, Dailekh and Okhaldhunga) 1 per cent were landless, 54 per cent cultivated land less than 0.5 ha, 25 per cent farmed land between 0.51 and 1.0 ha, and only 20 per cent have land over 1.0 ha (ERL, 1988, p. A5).

Manure/Fertilizer

The rate of organic manures application varies from farm to farm and year to year depending on the availability of organic manure. The average application has been 22 ton/ha for rice field; and, 11-13 ton/ha/annum for maize or wheat crop grown in rotation with rice as per Lumle Agriculture Centre in Kaski hills. Mineral fertilizer application does not exceed 50 per cent of the recommended doses; the cause being limited irrigated facilities, non availability in right time and right place, lack of credit, ineffective distribution and high cost of fertilizer.

Pesticides

Most of the pesticides sold are insecticides mainly used for rice, maize and vegetable; it is gathered that fungicides have as well been used on rice and vegetables in Kathmandu; and the list of commonly used pesticides may be categorized under insecticides, fungicides, herbicides and rodenticides in Nepal.

High Yielding Varieties

There are around 80 high yielding varieties of seeds released to be used by farmers under (a) paddy, (b) maize, (c) wheat, (d) barley, and, (e) finger millet, during the past 3 decades through researches and trial testing by the Department of Agriculture; out of those 9 varieties have been developed based on local materials.

Irrigation

The areas of land under some form of irrigation facilities were estimated (Department of Irrigation 1991) at about 943,000 ha; of the total facilities developed 72 per cent is contributed by farmers built facilities and the remaining 28 per cent has been contributed by public sector undertaking. The table below reveals that around 4 per cent area in the mountain, 20 per cent in the hills and 76 per cent of the area in the terai are under irrigation; and the ground water supply makes a coverage of around 12 per cent area for irrigation.

Table 20
Irrigation Facilities by Category and by Ecological Regions (up to 1991)

Ecological Region	Public Sector Facilities (in ha)		Farmers Developed facilities (in ha.)		Total
	Surface	Groundwater	Surface	Groundwater	
1. Mountain	333		33,163		33,493 (3.6%)
2. Hills	14,075	650	172,876	151	187,752 (19.9%)
3. Terai	225,653	26,600	386,303	82,912	721,486 (76.5%)
Nepal: Total	240,061	27,250	592,342	83,063	942,716
Percentage	(25.5)	(2.9)	(62.8)	(8.8)	(100)

Source : Department of Irrigation, 1991.

Percentage worked out are in brackets.

Fisheries

Total fish and fingerling production in 1990 amounted to 14,550 MT and 32.5 millions respectively with the average production of 1.82 MT/ha. Fish production activities have covered 60 out of 75 districts; and integrated fishery development programme are planned in 21 districts. The periodic plans emphasise the utilisation of potential water resources encouraging the private sector in aquaculture production and cage fishery. Integrated fish culture in ponds and cage fish culture programmes in lakes and reservoirs are being encouraged by providing loans to the private sector. Aquaculture development shows potentiality for expansion. Production trends for warm water fisheries indicate the attainment of sustainable development. Biological and limnological studies have been carried out in areas of intensive fish production on: i) feed and fertilizer, ii) fish disease and parasite, and, iii) growth technique for fish rearing. They have identified the problems, and suggested corrective measures such as the addition of quick lime, potassium per-manganate and trichloroform in fish farms. Besides, the Aquatic Life Conservation Act and Rule (1962) have been enforced to prohibit the use of explosives and poison in killing fresh water fish.

CHAPTER 12

Industry

Inception of Industry

Record indicates the inception of industry in Nepal with the establishment of Jute Mill (1936) in Biratnagar built up now as an industrial centre in Eastern Terai; later in the 1930s, and 1940s industrial waves without any sound and substantial base crept in to meet the demand during the Second World War without any lasting success of such industrial enterprises; and as such, planned industrial pursuits could be geared only with the launching of First Five Year Plan. During the past three and half decades there have been slow progress and industry is as yet to be deemed at the infancy level; nevertheless, Nepal has attained self-sufficiency in almost two dozen items of daily necessities.

Recorded Growth

In Nepal, the industry sector including power assumed a place of importance in all its development plans; and the first specialised financial house to be established was Nepal Industrial Development Cooperation (NIDC). The number of establishments increased from 514 units in 1960/61 to 9,359 units in 1986/87; with a total employment of 152,579. If the rice mills are excluded the total number of manufacturing establishments in the country comes to 3,633 with a total employment of 137,130.

In terms of number of units established, the growth recorded between 1965/66 and 1986/87 was more than seven fold. The average annual growth rate of industrial units from 1976/77 to 1986/87 was 15 per cent; while employment also increased by the same percentage. The annual average growth rate of fixed investment was 35%; and in terms of value added, the annual average growth of output over the period was more than 65%.

The number of industries with foreign collaboration has reached 117 units with the total authorised capital investment of Rs, 5,418.6 million by March/April 1991; the share of manufacturing industries alone constituted 73 per cent in terms of number; and more than 80 per cent in terms of capital investment.

Major Categories

The manufacturing establishments employing 10 or more persons constituted 56 per cent of the total manufacturing enterprises excluding grain mills in 1986/87; the increase in the manufacturing establishments over the four year duration (1986/87 to 1989/90) was 16 per cent. The table below highlights the importance of major categories of industries and their percentage contribution to the total number of establishment. Regarding employment four groups of industries : a) Food, b) Textile, c) Leather, and, d) Non-metallic products accounted for 80 per cent of the manufacturing employment. In recent years the organised cottage industry sector (carpet and ready made garments) has emerged as a major export sub-sector (Banskota et al, 1990).

Table 21

Growth of Manufacturing Establishments (with 10 and more than 10 persons engaged) by major NSIC categories 1986/87 to 1989/90, Nepal

S. No.	Major Categories	Census 1986/87	Survey 1987/88	Survey 1988/89	Survey 1989/90	Increment
1.	Food, Beverage, Tobacco	436 (21.22)	467 (20.18)	469 (20.09)	483 (20.25)	10 %
2.	Textile, wearing Apparel and Leather	474 (23.08)	538 (23.25)	510 (21.85)	533 (22.37)	12 %
3.	Wood and wood products including furniture	206 (10.03)	228 (9.85)	228 (9.76)	222 (9.32)	8 %
4.	Paper and paper products	109 (5.31)	111 (4.80)	107 (4.58)	111 (4.66)	1.8 %
5.	Chemical and of rubber and plastic products	140 (6.82)	144 (6.24)	159 (6.81)	170 (7.13)	21 %
6.	Mfg. of Non-metallic mineral products	503 (24.49)	625 (27.01)	662 (28.36)	655 (27.49)	30 %
7.	Basic Metal Industries	165 (8.03)	178 (7.69)	175 (7.49)	189 (7.64)	14 %
8.	Other Mfg. Industries	21 (1.02)	23 (0.99)	24 (1.28)	27 (1.13)	29 %
Total:		2,054	2,314	2,334	2,383	16 %
Percentage		(100 %)	(100 %)	(100 %)	(100 %)	

Source: CBS 1988, 1990 and 1991 (After EMAG, 1992, p.44)

Using the findings of NECG's survey of point source pollution, the industries have been categorised into low, moderate and high; of the urban-based manufacturing establishments, pollution prone industries constituted 64.17 per cent in 1986/87; and out of the total pollution prone industries, 7.86 per cent was highly pollution prone, 18.32 per cent was moderate, and 73.81 per cent was low pollution prone (EMAG, 1992, pp 28-29).

Urban industrial location

Following 1986/87 census of manufacturing establishments out of the total 9,359 establishments 3,112 were located in urban (Municipal) area and 78 per cent of these were manufacturing units other than traditional grain mills. Analysis of 1,589 manufacturing industries located in 11 major municipal urban areas, shows that 728 were in terai and inner terai towns, 766 were in the Kathmandu Valley urban areas, and 95 in the hill urban areas mainly Pokhara (IDS 1990). Kathmandu-Lalitpur, Biratnagar and Birgunj together accounted for 68 per cent of these industrial establishments. Following EMAG 1992 more than 80 per cent of the industrial activity in Nepal is reported to be concentrated in four major zones: a) Kathmandu Valley, b) Biratnagar - Itahari, c) Birgunj - Hetauda, and, d) Butwal - Siddhartha Nagar. The distribution of urban industrial districts are to be found in i) Dhankuta, Dharan and Rajbiraj in the eastern development regions; ii) Patan, Bhaktapur and Hetauda in the central regions; iii) Pokhara and Butwal in the western region; and, iv) Surkhet and Nepalgunj in the mid-western development region.

Haphazard Growth

In the Kathmandu Valley industrial growth and expansion has followed infrastructure facilities like roads, power lines and adequate supply of water; however, haphazard industrial growth and lack of concern for land use are evident everywhere; and such rapid and haphazard growth is seen also along the major north-south roads leading to the East-West high ways from Terai towns: i) Bargachhi-Itahari

road contiguous to and including Biratnagar, (ii) Janakpur - Dhalkebar Road, (iii) Birgunj - Jitpur Road, (iv) Hetauda - Bharalpur Road, and, (v) Butwal - Bhairahwa Road.

Problems of Pollution

The IUCN survey (1990) found 84 per cent industries having problems of air pollution: i) animal and feeds industries created moderate to very high air pollution; ii) composition of fuel gas emissions of cement factories, Nepal Vegetable Ghee and Bansbari Leather Industry emit SO₂ and NO₂ gases exceeding permitted levels. Effluents of industries like leather, textile, paper steel, soap etc constitute inorganic substance including toxic chemicals; while effluents from sugar, brewery and distillers tend to be rich in suspended and dissolved solids of organic nature; and all these make the river pollution situation worse. The extent of pollution control measures adopted by Nepalese industries is also recorded by IUCN Survey; out of 125 plants surveyed (a) 26(21 per cent) was rated as good; (b) 37(about 30 per cent) were rated as having satisfactory control measure; and, (c) almost 50 per cent of the industrial units had no pollution control measures

Capability Utilisation

Economic survey (1989/90) records that the capability utilisation of some of the manufacturing industries has notably risen: (i) Cement, bricks and tiles; ii) Jute; and, iii) Beer, Cigarette, sugar, etc.

Table 22

Capability Utilisation of Some Selected Manufacturing Industries (per cent)

	1985/86	1986/87	1987/88	1988/89
Sugar	36	58	73	58
Cigarettes	53	62	67	60
Beer	72	88	81	96
Matches	68	69	70	53*
Leather Shoes	69	74	11	13*
Cement	25	47	67	68
Jute Products	60	67	73	54
Brick and Tile	6	74	63	74

* Capacity increased due to establishment of more units

Source : Economic Survey (1989/90) (After EPC 1992, P.244)

Industrial Effluents

EMA Group Field Survey (EMAG 1991; Table 55 p.129) confirms that the industrial effluents contain various types of heavy metals including toxic elements - chromium, zinc and iron at high levels; nonfecal and fecal coliform bacteria have been recorded at a very high level of concentration in the industrial effluents of Kathmandu; and besides these the table below indicates high level of BOD, COD, N-NH₃ and chlorides in the effluents of various industries.

Table 23
Chemical and Biological Characteristics of Industrial Effluents

Parameters Standard	Bhrikuti Paper Mill	Raghupati Jute Mill	Golcha Industries	Jawalakhet Distillery**	Everest Paper	Balaju Industrial Estate	Patan Industrial Estate**	Pokhara Industrial Estate	Bansbari Shoe Factory	Carpet Factory	WHO EEC Standard
Temp. (0c)	–	23	23	–	–	23	–	21	25	21	
pH	11.2	2.7	3.3	–	6.3	7.25	–	7.5	11.18	6.92	6.
Total Solids	4667	–	–	–	–	–	–	–	–	–	–
DO	0	0	4.3	–	0.9	1.1	0	–	4	0	>5
BOD	918	988	28	1580	180	126	2210	610	460	320	1510
COD	3151	1480	43	–	311	198	–	880	794	411.8	3010
N-NH ₃	<0.1	1.92	2.2	–	<0.1	0.01	–	11.80	1700	31.80	1.0
N-NO ₂	<0.01										
N-NO ₃	–	0.11	0.12	65	–	0.65	45	0.21	96	0.80	45
P-PO ₄	–	0.6	0.10	–	<0.1	0.15	–	3.75	0.10	0.21	0.25
Chloride	–	416	842.4	800	–	202.95	85	223.6	6177	455.4	200
Sulphide	–	–	–	85	–	–	15	–	–	–	–
Chromium	–	–	–	–	–	–	–	–	4.2	–	0.05
Calcium	35										
Copper	<0.2										
Manganese	0.5										
Sodium	300										
Lead	<0.2										
Zinc	<0.2										
Magnesium	12.1										
Iron	1.8										

Source: A study on the Environmental Problems due to Urbanization in Some Selected Nagar Panchayats of Nepal, 1990, CEDA Kathmandu.

* Sharma, A.P. (1986): Study of Some Chemical and Biological Aspects of Drinking Water in Kathmandu, MAB, Nepal.

** Sharma and Rijal (1988): Impact of Industrial Effluent on Pollution of Rivers and Adjoining Land. A report submitted to the Nepal National Committee for Man and the Biosphere, Kathmandu.

(After EPC, 1992, p.248)

CHAPTER 13

Energy

Urban Fuel

Nepal's energy situation is peculiar in terms of its major reliance on fuelwood and paucity in exploitation of its vast hydropower potential; over 95 per cent of the total energy consumed is obtained from three traditional sources - fuelwood, agricultural residues and animal dung; and the commercial energy made up of petroleum, coal and electricity is in totality figure out to be less than 5 per cent. Thus forest and hydropower are the two major indigenous sources of energy in Nepal; forests are being depleted due to a far greater consumption of fuelwood than can be replenished in a substantial manner; and hydropower whose theoretical and economically feasible potentials are estimated at 83,000 MW and 42,000 MW respectively, has as yet in practice, remained as an urban fuel.

Energy Consumption

The structure of energy consumption during the decade 1979/80-1989/90 reveals: presently traditional energy and commercial energy are in the range of 96 and 4 per cent respectively; and during the decade the consumption of fuelwood has risen by 56 per cent and petroleum by 68 per cent.

Table 24
Structure of Energy Consumption

Source	1979/80 '000 TCE	Per cent	1989/90 '000 TCE	Per cent	Change Absolute	Per cent
Traditional	4,447	95.5	8,523	96.0	4,076	91.7
Fuelwood	4,341	93.2	6,786	76.4	2,445	56.3
Agricultural Waste	77	1.7	989	11.1	912	1,184.4
Animal dung	29	0.6	748	8.4	719	2,479.3
Commercial	209	4.5	354	4.0	145	69.4
Petroleum	158	3.4	266	3.0	108	68.4
Coal	31	0.7	21	0.2	-10	-32.3
Electricity	20	0.4	67	0.6	4.7	235.0
Total	4656	100.0	8,877	100.0	4,221	90.7

Source: Finance Ministry, Economic Survey, 1990/91, P.30, Table 4.1

Following LRMP record (1986 p.111) the annual requirement of fodder is assumed to be 16 million tons of dry matter and 35 per cent of it being derived from forest, it comes to 5.6 million ton; the other components - fuelwood and timber in terms of dry weight being 5.6 and 3.0 million tons the total supply from the forest amounts to 14.2 million tons; and major items cropping expressively are fuelwood and fodder which almost equal in magnitude being 40 and 39 percentages respectively.

Table 25
Estimated Supply of Forest Products

Product	Supply (000's tons dry matter)	Per cent
Fuelwood	5,625	40.0
Fodder and Compost	5,600	39.0
Timber	3,000	21.0
Total	14,225	100.00

Source: LRMP, Land Utilisation Report, Kathmandu 1986

Fuelwood Development

Forest being the major traditional energy source several agencies are involved with the forestry project implementation: a) Community Forest Development, b) Hill Forest Development, and, c) Terai Forest Development; plantations during 1979-86 was in the order of 96 thousand ha including 27 thousand ha of the community forest; thereafter, during 1986-92 plantation under various categories including private, community, lease hold forest it amounted to 122.8 thousand ha. Besides, 57.5 thousands of improved stoves towards minimising the fuelwood consumption were installed during the Seventh Plan period. The problem of fuelwood being very much involving the concept of Users Committies has been evolved, towards managing the forest and to make energy coverage through traditional sources by raising nursery and plantations. It has been estimated that there are over 3 million hectares of barren land which many be brought under afforestation schemes; and Eight Plan intends to a) constitute 5,000 users group, b) distribute III million of seedlings, c) make plantations in 67 thousand ha of land (including 45 thousand ha at the district level), and, d) hand over 252 thousand ha of community forest to the users group. Apart from that, lease-hold forest is to be allocated to 25,000 families in 40 districts; various forestry programmes are to be commissioned in 60 districts related to i) protection from natural disasters, ii) conservation to raise productivities, and, iii) community level soil conservation services; and landuse development is being allocated in five watersheds. Presently there is the demand of 11.7 million metric ton of fuelwood; sustainably around 5.7 million ton may be raised annually; furthermore, there is considerable problem in the midland and eastern terai in terms of fuelwood coverages. Regarding other bio-genetic energy there are two sources: a) agricultural waste, and, b) animal dung; quantified the former amounts to 600,000 MT which includes around 50 per cent paddy and maize straw and the latter used for energy comes to a magnitude of 2.3 million MT.

Hydropower

The economically feasible potentiality of hydropower is around 42,000 MW; these potentialities are shared in decreasing magnitude by the river basins of the Karnali, Koshi and the Gandaki rivers as shown below:

Table 26
Hydropower Potentiality

River Basins	Potentiality in 000 MW		
	Theoretically Potential	Economically Feasible	Percentage
Koshi	22.3	10.9	25.8
Gandaki	20.6	5.3	12.5
Karnali	36.1	25.1	59.5
Others	4.1	0.9	2.1
Total	83.1	42.2	99.9

The installed hydropower capacity by the end of 1990 was around 238 MW - 0.56 per cent of the economically harnessable potential; and this is made up by Kulekhani, Marsyandi, Trishuli, Devighat, Sunkoshi, Andhikhola, Thermal power and small Hydropower plants. Feasible projects are in various stages of investigation with a total capacity of 14.3 thousand MW; reservoir type seven multipurpose scheme amount to 87.6 per cent; and nine run-of river hydropower projects amount to 12.4 per cent. By the year 2000, the installed capacity is expected to reach 654 MW through planned projects when the peak power demand is expected to be 396 MW. About 44 per cent of the generated energy (in 1985) was consumed by the domestic sector, 34 per cent by the industrial sector, 6 per cent by the commercial sector, and the remaining 16 per cent by other miscellaneous sectors such as irrigation, drinking water, transport and street lighting.

Petroleum Products

Petroleum products constitute a very important energy source for Nepal; though their contribution to the total energy consumption is around 4 per cent, it absorbs 40 per cent of the total export earning. Comparing the consumption figures of 1960 and 1985 it is noted that percentage increase in diesel and aviation fuel are quite notable; furthermore the total consumption has gone up by 153 per cent. The transport sector is estimated to consume 49 per cent of the petroleum products imported. The construction of new roads is exerting a heavy demand for diesel as is the case with aviation fuel with increased domestic and international flights. The demand for furnace oil is also growing with the establishment of more and more industries. Kerosene oil, which is consumed for cooking, heating and lighting, is also increasing in demand; there was an 81 per cent increase in demand during 1983/84 as compared to 1982.

Table 27
Increase in Fossil Fuel Consumption

Type of Fossil Fuel	Consumption during (Year)		(in Metric Tons)
	2017 B.S. (1960)	2042 B.S. (1985)	Percentage Increase
Petrol	9,198	12,620	37.2
Diesel	11,221	59,284	428.33
Kerosene	26,431	37,985	44
Aviation Fuel	3,600	17,682	391
Total	50,450	127,571	153

Source: Corporate Planning Cell, Nepal Oil Corporation (NOC)

Alternative Energy

- (i) *Micro and small hydropower.* There are more than 25,000 traditional water mills in operation throughout the country. These are all of indigenous design, incorporating local materials and manpower. Most of these mills could be made more efficient in supplying energy for a number of applications with simple modifications. Various small hydroelectric programmes are in operation; around 1400 KW was generated in the Seventh Plan; work plans are enlisted to increase capacity of hydroelectricity by 5000 KW during the Eighth Plan; and the private sectors are encouraged to take the lead.

- (ii) *Biogas energy development:* While calculating in view of cattle population biogas plants may be constructed with capabilities of making energy coverage for 1 millions families; and this energy in totality may be estimated to a magnitude of 2400 MW. During the Seventh Plan 7000 plants were established the Eighth Plan has an objective of erecting 30,000 bio-gas plants - 12,000 in the hills and 18,000 in the Terai, and the energy generated may be estimated to a magnitude of 72 MW. For implementation the private sector is to be encouraged and the users may be provided loans through financial institutions.
- (iii) *Solar energy:* There is rich possibility of raising solar energy in Nepal; physiographically and climatically there are 300 sunshine days a year and 700-800 Watt of energy may be raised per sq meter. Use of solar heater has already become popular in the towns; these equipments and establishments have been produced by agencies which may be estimated to be 20 in number. Around 2,500 solar heaters and 5 solar pumps were in use in 1985-91. It is being planned to produce 5,000 solar water heater 2,500 solar dryer and 5,000 solar cookers during the Eighth Plan period.
- (iv) *Wind energy:* There is evidence of abundant wind energy in the northern mountain belt of Nepal. During the Seventh Plan period 20 wind velocity measuring stations were planned; the record indicates 20 KW wind energy was raised. Master plan of wind energy is to be prepared during early part of the Eighth Plan.
- (v) *Biomass energy development:* To make the effective use of biomass-technique of densification, gasification and carbonisation are being developed. Improved *Chulo* to a magnitude of over 57 thousands were introduced during 1985-91; and the current Eighth Plan target is to distribute 280 thousand of improved cook stoves to make effective use of biomass.

CHAPTER 14

Transport

Communication Linkages

The communication linkages are hard to establish and maintain in the hilly terrain; as such alternatives are to be sought to facilitate the means of transport; and towards that air linkages and ropeways have proved quite beneficial. Railways, trolleys bus are additional measures established in the flat plain and urban centres towards relieving the accumulated stress of transport problem. Before the inception of 8th Plan (1992-97) the road completed figure out to be 8,909 km: i) metalled 35.8 per cent, ii) gravel 25.6 per cent, and iii) dirt road 38.6 per cent. Following the figure of 1990-91 as 8,328 km the distribution of road in the five development regions in order of decreasing magnitude is: i) Central Development Region 38.2 per cent, ii) Eastern Development Region 23.4 per cent, iii) Western Development Region 18.9 per cent, iv) Mid Western Development Region 10.8 per cent, and v) Far Western Development Region 8.7 per cent. During 1989/90 the status of the road which was recorded to be 7,007 km was as: i) Highway 29.8 per cent, ii) District road 28.2 per cent, iii) Interconnecting subsidiary road 26.7 per cent, and iv) Urban road 15.3 per cent; and looked into its distribution physiographically it indicated 5.4 per cent in the mountain, 41.1 per cent in the hills, and 53.5 per cent in the terai. There are in all 43 airports; as per its capacity Jet can operate in one airport, Avro in eight airports, Twin-Otter in 30 airports, and Pilatus Porter in 4 airports; and the distribution of these airstrips are almost equal in all the three belts: 13 being in terai and 15 each in the mountain and the hills. Internal flights are being operated regularly to and from 36 airports and 10 international flights services remain commissioned to different countries.

Programme Coverages

The Eighth Plan makes the road programme coverages under major categories:

- I. *Stabilisation, reinforcement, maintenance and reconstruction of roads:*
Total 2,606 km; Budget provision 32 per cent
 - A) Stabilisation and reinforcement 1083 km (41.6 per cent): North-South road 40.2 per cent; East-West road 44.0 per cent; and Other subsidiary road 15.7 per cent.
(Table - 1 Eighth Plan p.317).
 - B) Maintenance of road 1,475 Km (56.6 per cent): Highway 60.3 per cent; and Subsidiary road 39.7 per cent. (Table 2 Eighth Plan p.318).
 - C) Reconstructions of road under destruction 48 Km (1.8 per cent).
(Table 3 Eighth Plan p. 319).
- II. *Road construction and upgrading programme:* Total 2,978 km
 - Fourteen districts centres are being planned to be connected by motorable roads;
 - Budget provision 57 per cent of the total outlay of 12,329 million.
 - A) Central Level Roads 1,778 km (59.7 per cent)

- i) Highway 763 Km: North - South 81.4 per cent; East-West 8.4 per cent; Others 10.2%; (Table 4, Eighth Plan p. 321).
- ii) Subsidiary Interlinking road 354 Km.
- iii) Road related to important development projects 561 Km (31.5 per cent of the Central Level Operated Road 1778 Km).
 - a) Roads in support of hydropower project 179 km; b) Road in support of tourism 40 km; and c) Road in support of other development projects 342 km (Table 6, Eighth Plan pp 324-5).
- iv) Urban Roads 100 Km

B) District Level roads (Farm to Market Road) 1200 km (40.3 per cent):

- i) Hilly terrain 480 Km (40 per cent); and ii) Terai 720 Km (60 per cent).

C) Bridges 25

III. *Village Transport Development Programme*: Total 955 Km.

- i) Trails 830 Km; and Service Track 125 Km; ii) High technology suspension bridge 500; and iii) Twin ghirling etc. 100.

Budget provision made 9 per cent of the total outlay of Rs 12,329 million.

IV. *Miscellaneous*: Budget provision 2.6 per cent of the total outlay of Rs. 12,329 million.

- i) Studies, survey, investigation; ii) Roadways laboratory; iii) Construction tools/spare parts; and iv) Support service/workshop.

V. *Provisions have as well been made for developing other means of transport with a budget provision of Rs, 1,235 million as follows:*

A. Ropeways: (with a provision of 12.18 per cent of the budget).

- 1) Surkhet - Jumla: to construct (if possible);
- 2) Kathmandu - Hetauda: to reinforce the existing line; and
- 3) To take up possible studies of other gravity ropeway and conduct experimental programme.

B. Railways: (with a provision of 10.1 per cent of the budget).

- 1) Reinforcement of Jayanagar - Janakpur - Bijalpura Railway station;
- 2) Bhairahwa - Butwal Railway;
- 3) Jayanagar - Janakpur - Bardibas (feasibility study of metre gauge/Broad gauge Railway line); and
- 4) Raxaul - Birganj - to upgrade to the broad gauge.

- C. Trolley Bus Services: (with a provision of 35.8 per cent of the budget).
- 1) Kathmandu - Bhaktapur (1975/60) maintenance;
 - 2) Tripureshwor - Kirtipur; Thapathali - Patan Dhoka - Pulchowk (Extension);
 - 3) Tinkune - Chabahil - Maharajgunj Ring Road (15 Km extension); and,
 - 4) Biratnagar - Itahari (22 Km).
- D. Development of Internal Water Route: (with a provision of 0.8 per cent of the budget).
- i) To work out river profile for Ramdi Ghat - Narayanghat - Bhainsalotan (187 Km) water route;
 - ii) Identify status of water transport from Bhainsalotan to Ganga river.
- E. Provision of Containerised Transport: (provision of 40.5 per cent of the budget).
- F. Control of Transport Pollution: (provision of 0.4 per cent of the budget).

Remarks

It is being observed with due satisfaction that:

- (i) There is the provision of maintenance and stabilisation of road with a fair share of budget provision. The North-South and East-West roads under Highway construction as well as in maintenance have been given importance. This is quite supportive to regional development. Under maintenance of road provision of 1475 Km for the highway is over 60 per cent.
- (ii) Roads in support to important development projects have been specified; and 561 Km thus set aside is around 31.5 per cent of the total road mileage projected under central level operation. The provision made related to hydropower project and tourism though strictly limited, it is going to raise critical observations whether such supports have been judicious in a given place and in magnitude; thus this allocation has been deemed significant.
- (iii) The District level roads with specification of facilitating market road to the farm is the policy oriented guide to develop market for the farm products encouraging land productivity.

Common Participation

Environmental impact of road construction has been studied in some of the representative north-south and east-west oriented roads; erosion, landslide and disruption of hydrologic channel are normally found; besides, the road has been the vehicle for expanding the area of deforestation and settlement. The level of awareness is now progressively built up at the decision making and implementation level recording that proper studies and strategies are imperative to minimise degradation as well as towards stabilising the road.

It might be profitable to examine the trails and service track, suspension bridges available to the village populations as well as the justification of periodic extension in terms of socio-economic development. The traditional pattern of maintenance and construction through common participation is essential to be encouraged and emphasised while determining essential fund required.

The roadways laboratory, support services of the workshop and provision of construction tool/spare parts categorised under miscellaneous heading are the basic establishments which need to be systematically developed with solid inputs. This requires external inputs in terms of technical know how, training and elaborate workshop exercises to ascertain that the vehicles obtained under precious aid or at the expense of foreign currency are effectively and appropriately utilised and systematically maintained to lengthen their active life.

Use of Hydropower

In the remote region ropeway installation is the major channel to open economic exchanges; as such it does appear enough attention in this part has not been paid so far. For regional development specially in all the major river valleys the role of the ropeways and cable cars may be economically productive and may create a lasting base for consequent developmental chapters.

The thought of laying down railway network and trolley bus services may be thoughtfully worked out with specific attention of the places for extension, the use of hydropower available in channelising the urban growth, as well as the volume of commercial transaction. Apart from the places mentioned in the plan allocation there may appear to be more needy places as well which have not been enlisted so far. The railways and trolley bus fed by power could be useful in other large valleys of the midland hills as well, towards minimising the volume of out-migration and to develop centres of development in various zones.

The development of internal water ways has been the listed item for investigational exercises for decades past; river profile of Ramdi Ghat-Narayanghat-Bhainsalotan is the potential requirement to be addressed to; furthermore, certain segments of the rivers aligned North-south or East-West including Trans-Himalayan section of Kaligandaki may be identified for waterways combined with hydropower establishments; besides, lakes such as Rara, Phewa group and myriads of glaciers and Glacial lakes, which if provided with distribution of cable cars, could develop alignments for enlarging rich tourist centers.

Private Sector

Private sectors have as well been joining to expand domestic air services; it is perhaps time to think over interlinkages of the Tibetan centers with the Himalayan establishments towards - i) feeding cultural schools coming down from centuries part, ii) encouraging and updating the economic and commercial openings which are mostly constrained or arrested, iii) circulating the people of remote settlements to the north as well as to the southern provinces for regeneration of new thought leading to sustainable involvements, iv) exercising plans of joint industrial undertakings by the high land populations of both countries based on potential resources therein; and, v) for initiating touristic interlinkages of the high land provinces. Such an adaptive outlook shall be the essential base to open the Himalayan frontier well ahead before the roads are ready to take up the north-south exchanges; and the remote region will advance far ahead in economic exchanges circulating amongst the highlanders and becoming ready very soon to have equal partnership with the southern establishments if such opportunities do open up in decades to come.

CHAPTER 15

Tourism

Master Plan

Open door policy came into expression after the advent of democracy in 1951. It was the conquest of Mount Everest in May 1953 that focussed the world's attention on Nepal. It was not until 1962 that tourist inflow was recorded. The Department of Tourism was established in 1966 under the Tourism Development Act 1964, even though tourism administration machinery was existent since 1956. The Royal Nepal Airlines Corporation (RNAC) came into being in 1958 and a few good hotels were built in the late 1960s. The Nepal Tourism Master Plan (NTMP) was formulated in 1972: the projected programmes were in two phases : (a) Phase I: 1972-75 for four years, and, (b) Phase II: 1976-80 for five years. The Master Plan formulated the concept of tourism market development by relating it to sight-seeing and trekking. The development programme initiated increasing accommodation facilities in Kathmandu, Pokhara, Tansen, Lumbini, and Chitwan; and, development of resort centres in Kathmandu, recreation or resort centres in Pokhara, Tansen, Lumbini, Chitwan, and, country-side resort areas in Gorkha, Trishuli and Ilam under the concept of regional tourism (Nepal Tourism Master Plan, 1972 p.175).

Tourist Inflow and Nature of Destination

Mountain Travel Programme was operated and Himalayan Trekking Private Limited was established in 1969 and to date there are quite a number of organisations involved at the government and private level for managing tourism in Nepal. Tourists coming for trekking and mountaineering are recordable from 1978 onwards; and the inflow of Indian tourists are notable in 1988. In 1962 the number of tourists as recorded is over 6,000, in 1975 over 92,000 and during the decade 1980/90 it rose from 163,000 to 248,000.

Department of Tourism statistics for 1987 indicates tourist inflow average annual growth rate of 6.7% over the past 10 years. The foreign exchange earning from tourism was NRs. 1.088 billion in 1986/87 accounting for some 26% of all earning excluding aid. In practice the number of tourists visiting Nepal are probably even higher, as large numbers of Indian tourists, who visit for religious or leisure tourism, are not included in the official statistics. Average spending per head is approximately U.S.\$ 170, indicating that the majority of these tourists are low-budget; although, many of these tourists never leave the urban areas and have no significant impact on the resource base. It is the 20-30%, who visit natural areas that potentially cause environmental damage but are as well providing significant economic returns in the hills; their numbers and destinations are shown in Table below.

Table 28
Natural Resource Tourism - Numbers and Growth Rates (1987)

Type of Activity	Number of Tourists Per Annum	Growth Rate
Mid-altitude trekking upto 6000 m	47,275	11% p.a.
High altitude mountaineering	796	1.1% p.a.
Rafting	3,612	320% p.a.
Wildlife tourism	25,844	rapid
Professional hunting	12	static
Religious tourism	30-60,000	n/a

Source: Ministry of Tourism, 1988; ERL interviews, 1989 (After ERL, 1989, p. c2)

In the hill and mountain areas, Annapurna, Sagarmatha and Langtang are the main destinations for mid-altitude trekking. Small airport in Namche Bazar and Jomsom make them easily accessible. Trekkers usually stay in locally run tea houses or travel with the agencies. In the Terai, most visit the Wildlife National Parks, Royal Chitwan and Bardiya, which have high-quality lodges in the Parks and locally run ones for low-budget tourists on the fringes of the Parks. Some of the major rivers, especially the Trishuli and the Sunkoshi provide the natural conditions for river rafting; the degree to which they are exploited depends on the ease of access to other destinations.

Mountaineering is carried out on some 104 mountaineering and 18 trekking peaks. Mountaineers make a series of camps on the ascent and require little infrastructure. Professional hunting is restricted to the gazetted hunting reserve, Dhorpatan in central region. The major attractions for religious tourists are traditional sites at Lumbini, Gosainkund, Khaptad, Manakamana and Gorkha, many of which are in the hills.

Economic Return

Both the environmental and economic impacts of religious tourism and hunting are being considered insignificant. Table below summarises the economic contribution of natural resource tourism, taking account of employment, direct expenditure and fee paid. The income coming to the country (in 1987) is around US\$ 4.8 million out of which expenditure in the area comes up to 89% and the remaining 11% is the revenue to the government.

Table 29
Natural Resource Tourism - Contribution to the Economy (1987)

	Expenditure in Area (\$ 000)	%	Revenue to Government (\$ 000)	%	Total per Tourist (\$)
Rafting (1)	11	0	11	2	6
Agency trekking (2)	2,392	56	117	23	115
Individual trekking (3)	1,148	27	206	40	53
Mountaineering (4)	728	17	173	34	1,131
Total	4,279	100	507	100	
(1) Rafting: average stay is 2 nights, with 6 people per boat and spending per head of NRs. 60 on food and NRs 120 on support staff; rafting permit is NRs 80/person.					
(2) Agency trekking: average length of trek is 10 days; average expenditure NRs 75/day; 4 local staff paid NRs 50/day each; trekking permit costs vary by length of stay but average NRs 135/person over the 10 days.					
(3) Individual trekking: as above, but spending is higher at NRs. 112.5/day and no support staff are taken; trekking permits average NRs. 202.5/person per trek.					
(4) Mountaineering: average expedition of 63 days and spending of NRs 75/day; for the first 18 days they employ 12 staff per mountaineer, reducing to two per mountaineer for the final 45 days; support staff are paid an average NRs 75 day; royalties depend on altitude, and are paid direct to HMG/N.					

Source: ERL estimates based on interviews with trekking agencies, Department of Tourism, Department of National Parks and Wildlife Conservation and Department of Immigration, 1989.(After ERL, 1989, p. c4)

Of the mid-altitude trekkers, agency trekkers make the largest economic contribution. Table below shows the total number of foreign visitors for each National Parks and reserve and the revenues earned by each.

Around 37,600 people visited the Parks in 1987, spending an average of U.S.\$ 105 per person; out of these visitors to Chitwan, Sagarmatha and Langtang are notable; and Chitwan singly commands 68% of the tourist volume. The revenue earned from National Park or Reserve (1987) comes up to US\$ 3.96 million; and Chitwan contributes 54.9% of the total revenue. In the last decade the number of tea houses and small hotels offering services to both individual and agency trekkers on the main trekking routes has more than doubled.

Table 30
Number of Visitors and Revenue of National Parks and Reserves (1987)

	Total Foreign	Total Revenue (NRs. 000)	Revenue per Visitor (NRs)
Sagarmatha NP	8,430	648	77
Langtang NP	3,151	201	64
Rara NP	73	4	60
Chitawan NP	25,611	2,175	85
Bardiya NP	233	632	2,711
Koshi Tappu Reserve	48	65	1,341
Suklaphanta Reserve	93	6	65
Dhorpan Hunting	12	230	11,167
Notes: 1987 Park entrance fees: NRs. 60 for foreigners, NRs. 5 for Nepalese. Park revenue also includes sales of construction timber, thatch grass and confiscated firewood; penalties for illegal activities in the protected areas (such as felling of timber, grass cutting, cattle grazing); royalties from hotel leases; consultant fees; and commercial timber sales			

Source : DNPWC monthly reports of wardens (personal communication, 1989); ERL estimates.
(After ERL, 1989, p. 5)

Impacts on the Resource Base

The direct impacts on the resource base from natural resources oriented tourism are :

- increased fuelwood demand leading to local deficits;
- ecological consequences of consistent overuse; and,
- environmental pollution.

(i) *Increased Fuelwood Demand*

Total estimated fuelwood demand from natural resource tourism was 6.4 million k.g. in 1987, equivalent to some 0.14% of the total hills fuelwood demand. Average consumption per tourist trip is 130 k.g., equivalent to 20% of the total annual consumption of the average hills household. While the absolute level of tourist demand is insignificant, the incremental demand is concentrated in small and often sparsely populated areas and may cause major increases in existing local demands.

(ii) *Ecological Impact*

In the hill areas, tourism is mainly concentrated in the National Parks. Edson (1988), describes signs of environmental degradation on the fringes of many of Nepal's Parks. This may have serious consequences for the sustainability of sensitive areas. Local demand accounts for 54% of the local sustainable supply. Based on ERL estimates of tourist demand, over 70% of the remaining harvest must be consumed by tourists.

(iii) *Environmental Pollution*

In the high altitude mountain Parks, environmental pollution made up of unsanitary waste disposal is cropping up in the trekker concentrated areas. This has been due to inadequate monitoring and management. An evaluation team described parts of Khumbu as a "high altitude litter dump" (Cullen, 1986). The recently opened Kanchanjunga Trail has already been reported as covered in litter (plastic bags and papers) by feasibility teams from travel agencies.

The table below indicates direct impact on (i) ecologically vulnerable areas, (ii) damage to watershed, and, (iii) aquatic life, flora and fauna; and, indirect input such as: (i) weakening of community incentives, (ii) increased income to improve resource management, and, (iii) displacement of families.

The impact of tourism may develop to be major and more severe as tourism expands. There seems to be no organisation attending to the responsibility for management of tourism impacts. The Department of National Park and Wildlife Conservation is more concerned with conservation and faces financial constraints. With the exception of the ACAP, management philosophy excludes rather than include the local people from the management of the area.

There are a number of immediate actions that will have direct impact on the resource management problem without requiring major changes to current institutional structures. These may be specified as :

- introduce the fuel sufficiency rule for all National Parks and protected areas;

- draw up management plans for natural areas which formalise economic incentives to local people;
- create incentives for investment in infrastructure to encourage diversification.
- levy a new environmental charge in dollars to replace the existing charges. The revenue to be distributed to the park management organisations.
- A reorganisation of management and monitoring under one organisation with additional responsibility of collecting and distributing the environmental charge to the Parks.

CHAPTER 16

Human Health and Environment

Severity of Food Deficit

The severity of food deficit is accentuated by the growing unemployment and under-employment. Small farms (less than 0.5 ha) of the hills rarely produce enough food to feed the family; consequently, they suffer nutritionally unless cash is brought in from off-farm sources of work to make up this deficit. When placed against an absolute cereals standard of "needs" (approximately 210 k.g. of cereal per year) small farmers and bari farmers in all size groups produce less than they need for subsistence.

Table 32
Cereals (Paddy, Maize, Millet) by Land Holding Size

Farm Size (ha)	Land Types	Average expressed annual reqts. (kg/head)	Cereal Production as % of			
			Expressed Requirements		Needs (@ 210 kg/yr)	
			1977	1978	1977	1978
0-0.5	OB	195.5	27	37	25	34
	MB	311.0	43	52	64	77
	B/K	234.6	32	45	36	50
	MK	271.2	53	76	68	98
0.51-1.0	OB	185.8	34	50	30	44
	MB	373.3	37	51	66	91
	B/K	328.2	59	85	92	133
	MK	305.5	66	89	96	129
1.01+	OB	222.7	62	62	66	66
	MB	377.9	30	45	54	81
	B/K	464.0	52	73	115	161
	MK	447.1	63	97	134	207

Note: OB=only bari; MB=mainly bari; B/K=bari/khet; MK=mainly khet etc.

Source : Conlin and Falk, 1979. (After ERL, 1988 p.A 67)

These deficits, in turn lead to extreme hardship. Cereal balance by household in 1977-78 (ERL, 1988 p. A.68) indicates that all farms are deficient in cereals in relation to expressed requirements. The most disadvantaged groups are small farm size farmers and only bari/mainly bari farmers. They produce 25 to 38 percent only of their requirements.

Table 33
Cereal Balance by Household and Land Holding Size

Farm Size (ha)	Household expressed requirements (kg/year)	Production as % of expressed requirements		Household Needs (kg/yr)	Production as % of Household Needs	
		1977	1978		1977	1978
0-0.5	983	37	52	951	38	54
0.51-1.0	1,261	56	77	1,010	70	96
1.01+	1,618	59	86	1,063	90	130
All sizes	1,256	51	73	1,008	64	91

Source : Conlin and Falk, 1979 (After ERL, 1988 p. A 68)

Malnutrition

Protein deficiency is a general problem and chronic malnutrition affects approximately 80 percent of the children with clinical malnutrition: children up to the 35th months of age are most seriously affected with peak prevalence rates of wasting between the 12th and 24th month (15%). The prevalence of wasting climbs after the age of two, while the stunted state climbs steadily from birth to age five (60%); growth faltering begins as early as three months age which reflects severe maternal malnutrition. The wastage rate for girls is higher than that of the boys in the hills. Iron and vitamin deficiencies are quite common in pregnant women; maternity death rate in rural areas is high due to lack of minimum medical care. About 77,000 people are estimated to be disabled due to blindness, deafness, paralysis, insanity, leprosy, polio and other causes.

Health

In Nepal health facilities is gradually on increase with the spatial distribution of hospitals and health posts; all the 75 districts are having public health section under the 5 Regional Directorates for promoting health services. The standard of health indicators have all improved in the past three decades mainly as a result of immunisation campaign, malaria eradication and with the increase of health facilities in urban areas as well as due to family planning. IMR and life expectancy show variations by altitude, gender, birth order, maternal age and spacing between births; while life expectancy has improved, female life expectancy in relation to that of males has deteriorated.

Out of almost 6,000 patients examined in Kathmandu (1986) nearly 36% were found to have respiratory diseases; recent investigation by Dr. Mrigendra Raj Pandey reveals close relationship between chronic bronchitis and the habit of smoking in Jumla; and spirometry analysis showed obstructed cases in Chandannath (Jumla) 62% and 57.4% in rural areas of Kathmandu.

Table 34
Health and Social Indicator

1.	Infant Mortality Rate (IMR)	102/1,000
2.	Child Death Rate under 5 yrs (born alive)	165/1,000
3.	Maternal Mortality Rate	850/100,000 births
4.	Life Expectancy (E)	54 yrs
5.	Total Fertility Rate (Children/per woman)	5.8
6.	Crude Birth Rate	37.5/1,000
7.	Crude Death Rate (CDR)	16.57/1,000
8.	Daily calorie supply (per capita)	2,077
9.	Population per doctor	30,220
10.	Adult Literacy (percentage of population)	36

Source: Eighth Plan, World Bank, 1992, World Development Report 1992

Table 35
Status of Health Services

1.	Hospital	111
2.	Hospital Beds	4,768
3.	Health Post (Sub-Health Post 3,199)	816
4.	Ayurvedic Medical Centre	155
5.	Doctor	1,182
6.	Mid Level Manpower Resources	6,557
7.	Village Health Workers	4,015
8.	Women Health Volunteer	24,00 (58 districts)

Source: Eighth Plan

Drinking water is heavily polluted in most of the urban centres and water borne diseases are very common and are very high during the monsoon season. Environmental pollution in the urban areas have severely affected public health. The high mortality rate is due to gastro-enteritis, diarrhea and other communicable diseases such as dysentery, cholera, typhoid, hepatitis, tuberculosis and meningitis; and it is estimated that at least 80 percent of the population suffers from these at any given time. Nepal has also the high incidence of iodine deficiency with about 70 percent villages in some areas suffering from goitre and with cretinism rates as high as 10 percent in some areas. The incidence of tuberculosis is also high.

Table 36
Population Served by Drinking Water Supplies, 1970-90

Population Served (thousands)	1970	1980	1990
Urban	461	714	1,196
(% of urban population covered)	(100)	(80)	(75)
Rural	186	862	5,753
(% of rural population covered)	(2)	(6)	(35)
Total	647	1,576	6,949
(% of total population covered)	(6)	(11)	(38)

Source: HMG, 1992. Water Supply and Sanitation Coverages. (Kathmandu: DWSS, MHPP)
(After NEPAP, 1993)

Environment

High erosion rate, landslides and river bank cutting have increased sedimentation and flood hazards; most rivers are subject to changing courses in the terai during the rainy season while in the hills bank cutting is a serious threat; and the problem of flooding in the terai is high due to high bed load carried by the rivers in addition to the suspended load. Encroachment of forest areas occur through the expansion of agricultural and grazing land; extraction of fuelwood, fodder and timber exceed forest regeneration and plantation rate; and extra crop lands in the hills are created by encroaching on marginal lands.

The quality of drinking water in major centres has been found to be poor. Water sources such as wells and springs are also used for drinking purposes; and the majority of these have been found to be contaminated during the rainy season. Water sample in Kathmandu, Pokhara, Biratnagar and in Terai indicate unacceptable level of fecal contamination and fecal coliform bacteria. Such contamination are

found even in the ground water of Kathmandu. The water quality of the rivers of Kathmandu valley has been illustrated in the Table below.

Table 37
Water Quality of Bagmati & Other Rivers

Parameters	Bagmati									
	Sundari jal	Gokarna	Pashupati nath	Thapa thali	Sundari ghat	Chovar	Khokana	Manohara	Dhobi Khola	Bishnu mati
Temperature °C	15.8	18.6	18.9	20.4	20.8	22.2	21.6	20.2	22.6	17.4
pH	7.6	7.2	7.4	7.6	7.6	7.8	7.9	7.6	7.4	7.6
Conductivity us/cm	28.8	46.0	76.2	191.0	322.6	208.5	234.4	140.0	284.0	226.0
Do Mg/l	8.7	8.2	7.4	6.3	3.5	6.0	6.6	6.12	6.14	4.36
Oxygen Saturation %	87.0	86.8	79.8	69.2	39.8	69.25	74.2	79.6	70.4	50.8
BoD mg/l	1.2	1.33	7.5	19.4	333.9	18.3	7.3	4.39	16.5	32.2
CoD mg/l	11.1	15.3	22.5	28.5	139.7	67.2	40.3	21.72	49.48	64.2
N-Nhg mg/l	0.13	0.05	0.18	0.99	7.18	2.33	1.5	0.45	5.96	2.30
N-Nitrite mg/l	0.01	0.01	0.02	0.09	0.14	0.23	0.10	0.04	0.10	0.09
N-Nitrate mg/l	0.21	0.21	0.34	1.07	1.09	1.22	1.09	0.66	0.53	0.62
Orthophosphats mg/l	0.1	0.1	0.24	0.29	0.58	0.13	0.25	0.25	0.13	0.46
Chloride mg/l	5.12	19.1	16.33	330.42	65.57	34.62	46.85	22.8	105.8	633.6
Total Coliform per 100 ml	nil to 706000							Upto 9600	107412	11520

Source: RONAST (1988), *Pollution Monitoring of the Bagmati River*, RONAST, Kathmandu
+ HFA, PPK and CEMAT 1991: Kathmandu Valley Urban Development Plans and Programmes
Environmental Policy Assessment, HFA, PPK and CEMAT, Kathmandu (After EPC, 1992 p.31)

The major water polluting industries in Nepal are leather, textiles, paper, steel, Kattha, rosin and turpentine, soap, sugar, breweries and distilleries, carpet washing and dyeing. Most of the industries are established close to water bodies which discharge even the toxic effluents without prior treatment; the dumping of domestic solids as well as untreated sewage, including dead animals along river banks are common practices which further lower water quality.

Il-ventilated housing system without chimney is the major cause of indoor air pollution; studies in Jumla indicates exposure to smoke for 8 hours or more can cause chronic bronchitis; and urban areas like Kathmandu Valley show increasing trend of air pollution. It is estimated that 18000, 3300, 1660 and 275 tons/year of carbon monoxide, hydro-carbons, nitrous oxide and sulphur di-oxide are being annually released into the valley air; besides there is a high level of lead content in dust and other particulates: (i) 3,000 gm/m³ on roads of heavy traffic, and (ii) 1,500 gm/m³ along road of less traffic.

It is common practice to dispose off toxic and industrial waste without any sorting and pre-treatment; industries dump their solid wastes on their premises or indiscriminately dispose them off in river beds or on public lands; and even the wastes containing hazardous substances such as heavy metals, cyanide and organic chemicals are released and disposed off into streams, rivers and municipal drains. Wastes from hospitals may consist of different composition from biodegradable to non-biodegradable; these may be paper, glass, tin cans, injection needles, human wastes, blood or body fluids; some chemical wastes are hazardous such as corrosive acids inflammable, reactive substances and genotoxics; and the total waste volume generated in 1986 was around 560 ton per annum or 1.5 ton/day.

Part

Responses

CHAPTER 17

Environmental Technology

Tradition of Agriculture

The nature of resource management is prescribed by the civilisation in a given place and time; and Nepal is no exception to that. The Hindu civilisation resorting to paddy cultivation, pastoralism and caste oriented division of labour prevailed up to 1200 m in altitude. Starting from hunting and fishery it passed through i) tuber culture (yam cultivation, ii) millet agriculture (African millet : *Eleusine coracana*) as summer grain, iii) rice cultivation (Asian rice *Oryza sativa* originating in Assam and Yunan), and finally resorted to iv) advanced tradition of agriculture engaging big animals - cattle/buffalo in ploughing the field; and this trend of agricultural pursuit permeated from south into the lower half of the Himalayan Hills.

Caravan Trading

The Tibetan Civilisation practising pastoralism, oasis cultivation and caravan trading prevails at the sub-alpine highland above 3000 m in altitude; it started from hunting and gathering of resources to i) domestication of sheep and goat (pastoralism), ii) plantation of barley and wheat in summer (as pursued in Mediterranean region): oasis cultivation - along with hunting; and, iii) raising of Yak, Dzo (hybrid of Yak and ordinary Cow or Ox) which ultimately developed long distance caravan trading. Hunting for meat lost its importance gradually as meat is liable to rot and also inappropriate commodity for long-distance trading. In contrast to meat such durable commodity as butter, cheese, wool, hide and salt became more important than before, keeping pace with the development of long distance trading. Thus an integration of oasis agriculture, pastoralism and caravan trading became the evolved pattern of subsistence.

Tribal Resource Management

In the rugged precipitous mountain between 1200 and 3000 m. traditional tribal culture made up of : i) upland field cultivation, ii) pastoralism, iii) forest preservation for hunting, iv) farming using organic manure, and, v) water conservation practices prevailed. In the daily life of the community tribal culture assumes major role; whereas, the adopted civilisational culture of Hindu or Tibetan school is important in the inter-community level; and these two layers of culture are fused into one in this region during the historical ages past. The inceptions of the tribal resource management are being traced in Nepal as follows:

- (i) Some centuries ago tribal subsistence depended on hunting combined with agriculture; settlement was small being of a few houses liable to be shifted from one place to another as per convenience of agriculture and hunting.
- (ii) The stage of clustered settlement as the core along with provision of three field systems - a) upland fields, b) *pakha* or grassland, and c) *jungle* or (natural forest) in concentric pattern developed. This, in other words, may be identified as the clustered settlement with agropastoralism *cum* forest preservation.

The settlement is usually composed of three aggregations - a) *Majh Gaon* (central village) located in the centre, b) *Siran Gaon* (upper one) second in origin, and c) *Puchhar Gaon* (latest foundation). The

fields are terraced into innumerable narrow strips; the slightly slope outwards reveals that these fields are not for water paddy, but for upland crops; and the terraces of the middle hills both for upland crops and rice cultivation in irrigable areas, were errorfully developed in the centuries past.

Management Practices

- (i) The beautiful terraces carved out in the hilly terrain are the testimony of the environmental technology developed through the ages with valuable inputs such as - i) observations on sustainable productivity, ii) consideration of conserving fertility, iii) retention of essential moisture, and, iv) stability of design in conformity to the evolving geomorphological features. The laying down of irrigation canal to provide nourishing water to the terraces of various levels reveal engineering skill and knowledge of hydrologic regime practised through the generations.
- (ii) The heat requirement for crop cultivation has been understood in practice; in the lowland crop rotation of maize (spring) and paddy (summer to autumn) within a year is frequently observed; on the other extreme single cropping of spring barley is observed at the Dolpo highland; and between these two extremes various kinds of crop rotations are observed. The coincidence between the available amount of warmth and a profitable kind of crop rotation in each altitude indicates that the people are always aiming for maximum amount of harvest within the allowance of climatic potential (Kawakita 1984 p.12, Table 2; p. 13, fig 5).
- (iii) Crop rotation is the system evolved to respond to the carrying capacity of the land in reference; seasonal migration to the lowland is the essential behaviour adopted to adjust to the resources available; rotational pasture came up as the pattern of resource management facilitating sustainable growth, and appropriate use of the meadow; and all these call for the effortful observations and experiences of the ages passing down to the generations in continuity.
- (iv) A definite pattern of crop rotation keeping the land fallow at certain interval has been evolved as a system through observations of several years in view of appropriateness to the specified geographical conditions of respective villages. The alpine grasslands called *bukyen* are the summer pastures of sheep and goats while cattle and buffaloes are depastured in the forest. After the harvest in spring (wheat and barley) and autumn (maize and African millet) the animals are driven to the field to get the land nourished with the dung and urine of depastured animals; and the attendants during such a period raise butter and cheese in return.
- (v) The close relationship between domestic animals and climate is referable: i) the habitat of Yak, *Changluk* (highland sheep) and *Chyangara* (high land goat) is restricted to the high places above 3000 m, and ii) Below 3000 m lowland varieties of sheep and goats are raised. The highland varieties of animals are economically far more excellent than the lowland ones in terms of tasty meat, long and soft wool and their inherent ability to be used as pack animals.

Observations in Record

Population pressure generating imbalance of landuse has been studied in the middle hills of Nepal by Kawakita (1984); it has resulted i) Shrinkage of forest, decrease in agricultural production and deterioration of Natural Environment; ii) Overgrazing near settlement and pollution of nearer springs resulting distress of health; and, iii) weakening of community solidarity, decrease in income and deterioration of quality of life as well as resulting inferiority complex and out-flow of talent.

Technical cooperation aimed at revitalising the degraded ecosystem records waiving off the negative elements such as:

- (i) Development of rational landuse is effective in curbing impact of population pressure.
- (ii) Pipeline and rope way project is contributive in ameliorating shrinkage of forest and decrease of agricultural productivity.
- (iii) Combining daily work with school education compensate labour shortage; and,
- (iv) Education of field science makes a substitute coverage against educational curriculum not related to local condition; and,
- (v) It is in general being observed that soil fertility, income and labour condition are on improvement (Kawakita 1984, fig 12).

Watershed Management

Watershed management programmes have been undertaken in all the eco-belts mainly in the midland hills. The nature of activities are: i) stabilisation of landslide, ii) rehabilitation of degraded terrain, iii) terrace improvement, iv) conservation plantation, v) trail improvement, and vi) provision of irrigation. The agro-forestry, the new system in adoption has gained popularity in view of its board coverages in meeting human needs quantifiable in economic terms.

Conservation and plantation exercises developed at Chautara and Pokhara have initiated sustainable efforts at the private counter, womens' level and amongst the community making regenerative practices to develop provisions of meeting the needs of fuelwood and fodder. The users group have been constituted in managerial exercises be it improved stoves, irrigation, water pond construction and maintenance as well as forest management at the community level. The watershed management programme activities at different districts, support to the National Park and Protected Areas; and the outlined programme activities such as horticulture, afforestation, rehabilitation of degraded features are the primary measures observed. Participation of the people and alleviation of poverty being identified as the basic factor, the concept of users groups has grown popular in the practice of conservative measures and in management of resources in the community as well as in enhancing the practice of leasehold forest. Extensions programme for promoting conservation with profitable return as well as in conducting income generation activities are on rise.

The selection criteria of the critical sub-watersheds within the district are prioritised in terms of : i) landuse condition, ii) landform situation, iii) slope gradient, and iv) population density. The sub-watershed management problems have been enumerated for essential exercise as: i) Landuse problems, ii) Food and population, iii) Fodder and livestock, iv) Timber and fuelwood, v) Erosion and landslide, and vi) income generating programme activities. Furthermore, the need assessments are mainly: i) Construction of spur, gabion wall, check dam to minimise river cutting, ii) Conservation of ponds/springs, iii) renovation of small irrigation system, iv) treatment of gullies, vi) plantation and conservation of forests, and vii) Landslide, torrent control towards overall rehabilitative implementation.

CHAPTER 18

Environmental Management : Policies Institutions and Monitoring Mechanisms

Internationalisation of Environmental Elements

Nepal's developmental planning begun in 1956, focussed on programme activities towards raising agricultural productivities, forest development, resettlement of the hill population in the Terai, surveys for transport network and industrial establishments to initiate regional development, preparation of Master Plan for Urban Development and Tourism as well as watershed conservation activities during the First Four Plan duration. Watershed conservation was pronounced as the major developmental theme and policies on (i) water resources and energy, (ii) National Forest Policy and (iii) Environment and Land Use Policy were enunciated during the Fifth Plan (1975-80). Ecological balance concept was fairly advanced in formulations of conservation, watershed management underlining the need of controlling population growth, minimising over dependence on agriculture and reviewing rules and regulations required to curve deterioration of urban environment; and exercises on Environment Impact Assessment were taking up during the Sixth Plan (1980-85). Environment was pronounced as the concern for National Development as a whole during the Seventh Plan (1985-90); major environmental elements were sought repeatedly to be included in the sectoral programme formulations and implementations including urbanisation/resettlement, industry, tourism, control of natural disasters; inter-sectoral coordinative efforts were initiated; and researches, data collection and analytical pursuits were brought as the operational requirement. Finalisation of National Conservation Strategy in view of making Basic Needs coverages for the people in general by 2000 A.D., and approval of the Master Plan for the Forestry Sector were the substantial outputs. Besides, institutional strengthening and EIA Guidelines for major sectors were exercised. Towards the end of the Seventh Plan the environmental status remained dismal : (i) degradation of the hill and migration to the Terai and urban centres, (ii) deforestation, desertification, loss of soil fertility, population growth and pollutions, were the major challenges. All these called for environmental elements to be strengthened in the plan formulation and environmental education for essential fore-sight and considerations on resource management.

In the Eighth Plan (1992-97) environmental elements were internalised in the relevant sectors as their essential constituents and in addition to that Environment has been adopted as a major separate sector. The policy enunciated may be referred to (i) strengthening of the ministerial planning units, (ii) analysis and improvement of traditional skill and technology, (iii) promotion of awareness to enhance people's participation, (iv) incentives for regularising conservative measures and to win industrial cooperation, (v) rehabilitation of degraded land, (vi) minimisation of pollution and recycling of the wastes, (vii) environmental management at the tourist centres, (viii) environmental studies in major construction and industrial establishments, and, (ix) legislative coverages to develop sustainability and integrated approach. Nepal Environmental Policy and Action Plan developed by Environment Protection Council (EPC) towards integration of environment and development has worked out its policy areas and relevant programmes under (i) Sustainable Management of Natural Resources, (ii) Population, Health and Poverty, (iii) Safeguarding National Heritage, (iv) Mitigating adverse environmental impacts, and (v) Legislation, Institution, Education and Public Resources. The policy area inter-related with specified programme and implementing agency becomes meaningful to judge the scope and effectivity of the policy and promote the competence of the institutional setting.

Institutions

In context of Resource Conservation and Utilisation Project (RCUP) undertaken in the Mustang District the need of multi-sectoral coordination was realised and National Commission for the conservation of Natural Resources was created in the Ministry of Forest and Soil Conservation; later in view of making effective coordinative arrangement as per recommendation contained in the National Conservation Strategy (1987), 'Council for Conservation of Natural and Cultural Resources (CCNCR)' emerged at the National Planning Commission; however as per importance recognised in redressing the environmental sphere a high level "Environmental Protection Council" (EPC) incorporating ministers of the relevant ministries and experts as well as institutional representations at the top levels, was created substituting CCNCR in 1992 under the chairmanship of the Prime Minister at the National Planning Commission. The relevant division of the NPC has been renamed as "Environment Protection Division" (EPD) and the secretarial work of the EPC is being reposed to the EPD under the Member Secretary of EPC. Environment Protection Bill awaits to be endorsed by the Parliament towards legitimising EPC and EPCS.

(i) *Parliamentary Committee*

The Lower House of Representatives have a Committee on Natural Resources and Environment which looks after all relevant natural resources and environment related legislation before it is submitted to the parliament.

(ii) *EPC designated Focal Points*

In order to facilitate the implementation of EPC's decisions as well as to coordinate the environmental activities at the ministerial level EPC has designated Focal Points at the Joint Secretary level of the chosen ten ministries: (i) Housing and Physical Planning, (ii) Industry, (iii) Law and Justice, (iv) Agriculture, (v) Water Resources, (vi) Works and Transport, (vii) Tourism, (viii) Education, Culture and Social Welfare, (ix) Health, and (x) Forest and Soil Conservation.

(iii) *Line Ministries and Departments/Corporate Bodies*

There are 22 ministries and 43 departments with full executive and quasi-judicial power; and besides the 10 ministries with EPC Focal Points additional ministries have been identified as being related with the environmental interlinkages in developmental program and implementation; these ministries may be added specially as (i) Finance, (ii) Home Affairs, (iii) Land Reform, and, (iv) Local Development. It might therefore, be necessary to get HMG decisions made about Environment Related Functions of Ministries requiring necessary revision in the Allocations of Business Rule 1990.

Environmental desks have already opened up in several departments including corporate bodies such as - Nepal Electricity Authority (NEA), Drinking Water Supply Corporation, and National Industrial Development Corporation (NIDC) See Annex - 5 (Institutional strengthening for Environmental Management in Nepal).

Table 38**Environment Related Administrative Structure in Departments**

S. No.	Departments	Environment Section
1.	Department of Forest	<i>None</i> (Planning Division)
2.	Department of National Parks and Wildlife Conservation	Ecology Section
3.	Department of Soil Conservation	<i>None</i> (Planning Division)
4.	Department of Housing and Urban Development	Urban Environment Section
5.	Department of Industry	Environment Section
6.	Department of Roads	Environment Section
7.	Department of Health Services	Environment and Community Health Section
8.	Department of Tourism	<i>None</i> (Mountaineering and Planning Section)
9.	Department of Nepal Standards, Weights and Measures	Industrial Pollution and Monitoring Section
10.	Department of Water Supply and Sewerage	Environment and Sanitation Section
11.	Department of Irrigation	River Training, Environment and Equipment Division
12.	Department of Agriculture	<i>None</i> (Planning Division)
13.	Nepal Electricity Authority	Environment Study Unit
14.	Drinking Water Supply Corporation	<i>None</i> (Planning Section)
15.	Nepal Industrial Development Corporation	Environment Section

(After : IUCN/ADB Task Force Report 1994, Annex-5, p. 49)

(iv) *Private Sector Organisations*

Consulting firms such as New ERA, EAST, SILT, CEMAT, Multi-disciplinary, Nepal Consult etc. have established credit in accomplishing environmental studies. Private and public sector industries usually have provisions of a small laboratory run by their chemists/technicians. There are 33 private laboratories (IUCN, 1993) each with varying degree of analytical sophistication. The recently established Nepal Environment and Scientific Services (NESS) is equipped with facilities for air, water, noise analysis (IUCN, 1993).

(v) *Non-Governmental Organisations (NGO)*

NGOs related to environmental activities are rising in number; the most notable in view of their contribution may be noted as : (i) King Mahendra Trust for Nature Conservation (KMTNC), (ii) Nepal Forum for Environmental Journalist (NEFEJ), (iii) Environmental Camps for Conservation Awareness (ECCA), (iv) Nepal Environmental Conservation Group (NECG), and (v) LEADERS.

Monitoring and Evaluation

The importance of Monitoring and Evaluation in promoting the quality and efficiency of programming and implementation has been realised at the policy framing level and there is the created provision of Central Monitoring and Evaluation Division requiring exercises of this mechanism at the ministerial and departmental levels as well. In such a context environmental institutions as well need to make evolving provision for that.

CHAPTER 19

Communication for the Environment : Education and Awareness

Extension Programme

The resource management and need of raising productivity and later the concern in the environmental management led the sectoral agencies evolve extension programme towards (i) raising the level of knowledge in the practice of newly adapted technology, and, (ii) increasing the participation of people in land use and conservation farming. The departments of agriculture, forestry started radio programme "*Budhi Ama*" specially designed for the farmers; the department of health on nutrition, hygiene and sanitation; and the department of Soil Conservation having conservation and management activities in the representative ecological belts worked out; (i) training, (ii) study tour, (iii) seminar, (iv) film show, (v) conservation education (vi) extension materials etc. and recently organised Users Groups in conservative exercises. The major work of the Department of Soil Conservation and Watershed Management has been : (i) control of erosion, (ii) rehabilitation of the degraded land, (iii) nursery raising, distribution of seedling and plantation in the barren land, (iv) management of community forest, trails, ponds (v) economisation of fuel wood by using improved cook stove etc. And these were the basic text or communication in building up awareness and promoting the level of environmental education.

Environmental Communication

The Nepal Forum of Environmental Journalists (NEFEJ) exercised the talents of the journalists in reaching the people in the sphere of environmental communication and awareness building activities. *Bhitte patrika* (wall newspaper) was composed on certain topics of meaningful concern such as : (i) cash grows on trees, (ii) Fuel can be made from husk of paddy, (iii) More problem will be faced after the tree goes (iv) The landslide finally stopped and, (v) Traffic pollution. They resorted to Radio programme with referable topic : (i) paddy cultivation as a means to save the soil, (ii) pollution and productivity, (iii) degradations/management of the Ramechhap Forest, and, (iv) explaining major themes of Environmental Posters built up by UNEP; furthermore, environmental responses from various parts of Nepal including youths/farmers and students were as well incorporated. Training, seminar, story award and investigative reporting fellowship stimulated the journalists in orienting their curiosity in the environmental sphere as well as in building up capabilities of communication with various levels of the people. It facilitated developing contact Focal points at various sources of environmental problems as well as in reaching experts, policy makers, politicians, social workers for building up opinion communicable profitably for interaction, and in problem resolving and decision making pursuits. *Deurali* a Nepali weekly coming out as village newspaper from Tansen specifically for Palpa district contains texts referable to (i) water mill, (ii) river training, (iii) plantation and horticulture, (iv) pesticide, (v) private fruit and forest guard training, (vi) skill promotion training, (vii) Aids, (viii) womens' role, (ix) smoking and its impact etc.

Environment Management Programme

National Conservation Strategy (NCS) Implementing Project has developed its programme on the nuclei of the NCS Vanguard Programs based on specific model for each geographic division of Nepal. Following that towards building up environmental education and promoting conservation awareness, several NGOs have been commissioned to work on specific project area under NGO Environmental Management Program (NEMP). Environment Education refers to conservation through paintings and

to environmental messages mobilising singers and actors; it refers to rural environment, conservation and development project and dwells on income generation programmes; it motivates the school students on the one end and exercises on developing tourists' information centre on the other hand; and it develops a program of training by conducting village workshop towards prioritising issues for harvesting natural resources. The NEMP programme have been distributed far and wide in the Mountain, Hill, Terai districts, Kathmandu Valley, Patan Municipality, and Makalu-Barun and protected areas. The NGOs engaged belong to the youth society : Rural Environmental Conservation Group, Hill Area Development Foundation, Womens Centre and Committees, ECCA, and Kathmandu Environment Education Project. ECCA activities of the rural area are made up to (i) generate a sense of awareness amongst children, (ii) encourage young people to take up conservation and related activities, (iii) teach children good outdoor habits, (iv) provide new insights into environment protection and resource management. At the district level the dissemination of environmental education is made up to : (i) stop forest fires and deforestation, (ii) educate people about sources of water, (iii) develop income generation programme and grass production; and the environment education to the tourists provides the information on (i) Altitude and geographic terrain and distance, (ii) fragility of local environment and culture, and (iii) locally established values - social, religious and cultural. Apart from all these NEMP may be recorded in being involved with the following :

- (i) Community management of the solid waste at the Patan Municipality in terms of creating awareness, bringing changes in human behaviours and promoting sustainable management.
- (ii) Introduction of bio-gas technology in certain areas adjacent to Royal Chitwan National Park in terms of reducing pressure on fuel wood, increase food productivity by the use of organic fertilizer and prevent livestock grazing in the park.
- (iii) Minimising impact of tourism on the environment and culture of Nepal.

Street Theatre

The proposed project on Street Theatre as a media for developing public awareness, about the importance of the Role of women in Natural Resource Management and the inter-relationship of population and Natural Resources, developed by NPC/IUCN/UNFPA, seems to be an effective instrument to mobilise the rural world of Nepal as :

- (i) Traditional and folk media have been effective in the communication and promotion of new ideas, and adjustment to emerging order without any constraint of language barrier, level of knowledge, acceptability of message for easy consideration and in terms of retention of messages delivered even after several months.
- (ii) Radio and television media do command limited circle : 33 out of every 1000 Nepalese are reached by radio and one in a thousand Nepalese has access to a television set (Human Development Report UNDP, 1991).
- (iii) Performance is to be made by a professional theatre group amidst rural audiences incorporating local situation, gender, role of the target villages, considering regional diversity and including local dialect and phrases.

- (iv) The tentative program sites will be in districts where NCS implementation project is already working; and the outreach of the programme is to be increased through schools, local community groups, NGOs, Production Credit for Rural Women (PCRW), and Small Farmers Development Programme (SFDP).
- (v) A manual with a skeletal script and guidelines will be provided as the base; the Steering Committee will outline the information area to be focussed and identify appropriate types of messages to be delivered; and the folk tales and traditional beliefs related to environment will be closely examined towards bringing effective use of the resources.

The performances at 225 sites in 9 districts over a period of 3 years seem to be a profitable investment; the training workshop opens an opportunity to the promising local theatre group; and the encouragement to charge entertainment tax for subsequent performances will generate self-sustainable source for the near future performances. Besides, the video films of the street theatre may justify all the efforts and expenses as it would be very much profitable for all the villages of Nepal in promoting public awareness and in initiating cooperative inputs from the larger sector of the poor community which has not been often focussed in terms of access to them.

Educational Resource Material

NCS Implementation Project has been able to work out school curriculum for classes 1-5 and 6-8 towards internalising environmental themes as essential supplement. References do crop up about introducing the subject at the higher level; but so far the response towards that has been sectoral and peripheral.

Newsletter

The quarterly Newsletter of the National Conservation Strategy has been valuable as it incorporates the results of the environmental investigation, policies, legislations, institutional arrangements and information of the projects undertaken; materials under focus, profile do help in knowing additional works and emerging pursuits at various institutes; interviews coming up update the opinions built up at various enclaves and the review of the publications are useful. NEFEJ News Letter reports the environmental activities mostly organised and participated by the journalists; it does follow up environmental problems emerging, meetings/trainings and seminars at various levels, and problem activities both at home and outside.

Meetings/Conferences

NEFEJ is quite ahead in building up environmental awareness of the politicians, parliamentarians and leaders through technical presentations and socio-economic interactions. In such a pursuit inputs of the available experts are often sought. With the inception of Global Environment Facility GEF/SGP (Small Grants Programme) involvement of NEFEJ in the environmental projects through NGOs is on increase; and it is seen that 8 percent of the projects approved under GEF/SGP falls under training and awareness. NCS Implementation Project regulates the meetings of the experts towards utilising the updated opinion under rigorous interaction. This is the field requiring healthy exercises and nourishing inputs. As such NEMP Project on "Regional Conference on Environment and Biodiversity" specifying its objectives of bringing scientists and experts together in sharing the experience and discussing the problems of the region, attracts attention in view of the growing concern in the sphere of environment and the need of piloting activities effectively with due justification.

CHAPTER 20

Regional, Sub-regional and Global Responses

Conservation Programme

Nepal was engaged in reducing population pressure in the Hills and reclaim forest land for agricultural productivity; internal resources were being sought for regional development; and programme activities such as land use surveys, Conservation of Watershed and Tourism Master Plan were in exercises during the decade 1965-75. At such a period of reference Stockholm Conference 1972 on Human Environment, Salzburg Panel of Experts (Feb. 1973) dwelling on crucial ecological problems of the high mountains connected with (i) The Andean Ecozone, (ii) Man/environment relations in the Himalayas, (iii) Man and Mountain Ecosystem in the Alps, and, (iv) concept of carrying capacity of the resources; Lillehammer working group (Nov. 1973) outlining an international coordinated program on (i) resource development and human settlement in high tropical mountain, (ii) tourism, technology and land use in temperate mountains, and, (iii) land use problems with reference to grazing, industrial development and recreations, were the appropriate UNESCO MAB programmes in active operation to initiate Nepal taking up conservative exercises.

Programme on Man and the Biosphere thus was begun in 1974 with NGO institutional structure of "Nepal National Committee for Man and the Biosphere" in the frame-work of Nepal National Commission for UNESCO (1971) under active operative mechanism of National Planning Commission. The UNESCO Regional Meetings on Europeans Alps (Vienna, Dec. 1973), on Sahelian zone (Niamey, March 1974), on Andean Region (La Paz, June 1974), on Humid Tropical Ecosystem of South-East Asia (Kuala Lumpur, August 1974) were the justified built-up nuclei towards organising Kathmandu Regional Meet (Sep./Oct. 1975) on Integrated Ecology in the Southern Asian Mountain System particularly the Hindu Kush-Himalayas which recommended setting up of a Regional Institute for integrated mountain development.

Call for Regional Cooperation

The nature of national involvements during the decade 1975-85 was to (i) maintain ecological balance controlling flood, landslide, erosion, management of forest and conserving flora and fauna; (ii) achieve sustained economic growth and social benefits from forest, (iii) establish industries outside populated areas to control pollution, (iv) develop tourist places with due consideration to environment, (v) control population, emphasize watershed management, reduce over-dependence on agricultural productivity, and (vi) exercise Environment Impact Assessment (EIA) of development activities. King Birendra Bir Bikram Shah Dev propounded Nepal's policy of regional cooperation in utilising potential water resources of the Himalayas in terms of economic growth, and wellbeing of the populations of the region (Inaugural Address to the 26th Consultative Committee Meeting : Kathmandu Dec. 1977). And Soil and Watershed Conservation Act (1982) is recordable in context to all these. In the non-governmental sector conservation activities were perceivable with the coming up of the NGOs: (i) Nepal Nature Conservation Society (1976), (ii) Nepal Environmental Conservation Group (NECG, 1982), and (iii) The King Mahendra Trust for Nature Conservation (KMTNC, 1982) supported by specific Act and having international linkages in pursuit of nature conservation, investigations and implementations.

Institutional Setting

It is notable herein that the South Asia Cooperative Environment Programme (SACEP : Colombo 1981) emerged to initiate cooperative programme in the region, International Centre for Integrated Mountain Development (ICIMOD : Kathmandu 1983) came up to address issues of Hindu Kush-Himalayas, and, International Union for the Conservation of Nature and Natural Resources (IUCN : Kathmandu 1983) established its project office to exercise National Conservation Strategy (NCS) for Nepal. This kind of institutional setting has been strategically significant in stimulating national operations, promoting regional concern in environmental issues and in emphasizing regional cooperation by SAARC (1985) in studying and mitigating issues of Natural Disasters in the region. Commitments towards promoting Biodiversity and pursuing effortful exercises to minimise change of climate have further enhanced Nepal's responsibilities in making continued responses at the sub-regional, regional and global levels.

Major River Projects

Concern on the importance of water project development may be traced in the Nepal/India water utilisation project (the Sarda Canal Project of the Mahakali, 1920) and in the Koshi and Gandaki projects during the 1950s; the environmental issues remain mostly neglected in terms of highland rehabilitation and low-land prosperity; and the benefits coming to Nepal out of these projects are severely limited. This is a matter of concern to the people in general; the evolving technical population and the political setting of Nepal seek sub-regional exercises faithfully towards minimising imbalances of benefits and activate cooperative network at various levels. Attention has been focussed to the north as well in pursuing concern on the risk of Glacial Lake Outburst and the water potentiality as Nepalese trans-Himalayan Rivers are having major part of catchment in the Tibetan plateau of China. As such the use of water in Tibet, potentiality of sustainable use of water in generating power and in irrigating land in Nepal as well as the ecological and economic consideration in the Gangetic plains of India are the subject of major concern requiring sub-regional/regional attention; besides, international River Agreements as well may have to be evolved at certain stages to maintain judicious behaviour and faithful undertakings in terms of ecological balance, environmental consideration and economic development of the relevant frontiers. The land use of the mountain and Middle Hill towards supporting hydropower establishments and industrial nuclei, watershed management, including forest, pasture and agricultural productivity, regional balance through developmental network, urban growth and commercial establishment, and eco-oriented economic establishments nurturing the protected area with positive inputs for supporting biological diversity, are the scope of the programme activities needed to be inter-linked wherever referable with the river basin development.

Protected Areas

Brown and Wolf (1986) limited declining grain production during the 3 decades (1950/2-1982/4) in Nepal and Bangladesh to the severe ecological degradation that these countries were experiencing with regard to deforestation; the suggestive argument was the need of creating network of natural reserves and protected areas towards promoting genetic diversity; and in such exercises acceptability of the people in common, upgrading of scientific support and sub-regional cooperation may be recorded as pre-requisites. As in other parts of the world the network of protected areas in Nepal expanded mostly in the 1970s with the support of National Park and Wildlife Conservation Act 1973; and the efforts so far put in this direction have been recognised and credited internationally. It may be noted herein : (i) existing protected area are under constant threat and are shrinking as reported in Shuklaphanta National Park (Chalise, 1991 p. 687); (ii) illegal trade and harvesting of natural resources : Sal and Khair, musk, rhino horn, bear gall bladder and Flikingeria orchid plants are quite rampant

(Chalise 1991, p. 680); (iii) Makalu Barun National Park is considered unique representing various ecosystem zones in near pristine condition (Taylor-Idle and Shrestha, 1985); and, (iv) the aspect requiring immediate attention to justify maintenance of these protected areas through periodically conducted systematic survey of existing biological species to ascertain positive evidence of protection and promotion of endangered species.

Besides, there is the need to endorse "Convention on the Conservation of Migratory Species of wild Animals, 1979 to engage in joint action with the southern neighbour who has signed the convention in 1982 to maintain the Convention on International Trade in Endangered Species of wild fauna and flora (CITES 1973) in functional practice. It is now time to work out Regional Conservation Strategy to facilitate bilateral network arrangement to find out the possibility of expanding the National Park and protected areas in the trans-national provinces to safeguard and promote the major objectives of protecting wild life and enhance genetic diversity.

Cooperative Program

Traditionally, culturally and economically Nepal has been in response both to the northern plateau and southern Gangetic plain in regulating its operations since time immemorial for expanding understanding, credibility and institutional frame-work required locally or regionally by adjusting the political climate from time to time. With the inception of environmental concern the scope of understanding and working relationships have extended to the broader frontier to which we may appropriately call the region. The ecological peculiarities of the rivers emanating from or beyond the Himalayas, the hydrologic regime, weathering and sedimentation process, climatic assemblages and the fauna and flora generated therewith are the subjects of our concern focussing centrally the sustainable development and well-being of the human populations in the region. In such a context apart from national obligation and in continuation to faithfully responding to the continued national pursuits there is an urgent need of shedding off political boundaries to build up recognition of Macro-ecoprovinces which remain regulated with inter-linkages and inter-dependence under the Law of Nature in the course of its creative programme activities or in arresting the cycle of degradation. The needs of individual nations, the institutional setting built-up, the policies and enactments worked upon, the international convention, agreements endorsed are all the measures periodically identified as essentially related to national objectives. With the adoption of Regional Conservation strategy several adaptations, in the interest of the region and alterations towards enhancing national prosperity, may become imperative; and having all these internalised in our conceptual background, the environment of regional consideration and the joint programmes call for reciprocation and cooperative inputs from the nations around. As such SACEP (1981), ICIMOD (1983), and SAARC (1986) are having major problem in common towards delineating scope and nature of its own involvement in the major task of enlarging and enhancing cooperative programme.

International Agencies

Bilateral and multi-lateral agencies including NGOs, UN bodies and World Bank engaged in sectoral projects have now adopted integrated approach in the basic nature of their operations; and besides this, some of them have offered to take up projects on environmental issues as well. It may be recorded herein : (i) IUCN remains engaged in National Conservation Strategy Implementation Project extensively; (ii) The World Bank (funded by the U.K. overseas Development Administration) pursued studies on Natural Resource Management for sustainable Development in collaboration with the National Planning Commission and remains available to consider judicious inputs in seeking applicable solution to certain identified environmental issues; (iii) UNDP has been coordinating donor agencies in upgrading attention to the environmental theme to ascertain a balanced input towards the urgent

concern of the period; and WHO has in consultation with EPC, offered to implement a programme on Nepal Environmental Health Initiative (NEHI), four year National Programme as per Agenda-21 of Rio Declaration in cooperation with concerned agencies at the national level to reinforce "Health and Environment in sustainable Development".

It does appear that it is now time for Nepal to develop bilateral programmes with institutes in the Himalayan region as well as work out applicable theme for interaction and collaboration with other countries in the region. Experiences so far have indicated that over-dependence on the Government Machinery and existing institutional network may not bring desired magnitude of progress; and increasing responsibilities need to be germinated progressively in selected non-governmental and private sectors; so that intrinsic potentialities may be raised for increasing creativity and to utilise the myriad pockets of internal resources as well as to initiate required exercises of genuine faithfulness and accountability in practice. Restoring such a ramified responsibility to the private sector in years to come, the governmental agencies may be looked upon for appropriate allocation of the available resources in working out effective policy formulations, enactments, as well as periodic guidance in resolving issues and for patronisation of the specific investigational pursuits, at the national, bilateral, regional or international levels as and when it becomes imperative.

Part

Challenges and Opportunities

CHAPTER 21

Follow-Up of Agenda 21

Challenges to Sustainable Development : Concept, Policies and Issues with Regional and Sub-regional Focus.

Aspiration of Nepal

The Agenda is made for expressive action to control population growth, to waive off hunger and minimise poverty by adjusting the pattern of production and consumption in view of limitation of resources and the need of exercising sustainable development, and to initiate regenerative revolution with interlinkages between local, national and regional agencies towards promoting understanding and cooperation in the international sphere for establishing ecologic equilibrium in global context.

The national aspiration of Nepal has been to avail basic needs of the people through economic development, to update technological appliances and promote capabilities for resource management, and to harness the potential resources in a sustainable manner towards promoting agricultural productivity and expand industrialisation with economic and ecologic considerations. The problems of the mountainous country with population pressure are deforestation, degradation of productive resources weakening the agricultural productivity, proliferation of environmental problems both at urban centres and rural frontiers and ineffectiveness of programme implementation.

At such a crucial moment emerging major issues need to be identified periodically, and priorities to be ascertained to establish an order of implementational interlinkages giving lead to positive achievements which in stages, make a productive base for further programme activities. The policies framed up with insights of resolving the issues through programme activities, are to be reviewed to promote functional values and sharpen their applicabilities by the institutional mechanism available, towards ensuring the vital relationships in-between developmental sense and economic justification.

The Principles of Rio Declarations

Elaborating (i) Human being the center of concern, (4) environmental protection, (7) global partnership to conserve, (8) elimination of unsustainability, (9) strengthening endogenous capacity building, (12) international economic system towards supporting economic growth and sustainability, (15) precautionary measures to threats of irreversible damage, (16) internalisation of environmental costs, and (22) role of indigenous people and their communities, are the essential base nuclei for major understanding; these are the specific elements for exercises to build up developmental framework at the local and national level, as well as to develop consultation and cooperative programmes both at the regional and international enclaves. Agenda 21 based on these principles and seeking faithful exercises may be looked into in each section towards following their relevance and urgency of programme area outlined, in context of national objectives and priorities of Nepal.

SECTION 1 : Social and Economic Dimension

- Environment and Development in terms of sustainability, poverty alleviation, resource productivity, economic accountability, population management, and local level resource management need to be essentially exercised in policy orientation, programme elaboration and in improving implementational exercises.

- Health care in raising national capabilities, population management and development of rural/urban interlinked and balanced development, as well as in establishing nutrition and ecological interrelationship need to be effortfully pursued to make sense to all the inputs made so far.
- Migration of the people from the hills to the terai, from the rural provinces to urban settlements have raised acute problems of land use planning, urban settlement requiring increasing provisions of water, sanitation, drainage and solid waste disposal. This is the challenging front needed to be addressed to in practice, for resolving the issues connected to health, environment, and economic productivity.
- Energy, transport and water management required both for socio-economic promotion at the settlements as well as for streamlining the trend of industrial growth are the concerns at the priority levels requiring meaningful action.
- Decision making procedures and capabilities incorporating environment need promotion with the sense of faithfulness and realisation of urgency. Records so far underline the importance of decision making in an updated and efficient manner to ensure best use of the resources allocated.

SECTION 2 : Conservation and Management of Resources for Development

- Degradation of forest and land need elaborate attention towards - (i) promoting agricultural productivity; (ii) developing potentialities of the natural resources; (iii) rural income with alternative livelihood; and (iv) industrial growth at suitable sites in conformity with ecological provinces.
- Deforestation has impoverished the bio-wealth and as such steps related to promotion of bio-diversity and bio-technology are the topics of serious concern to ensure human survival.
- Water quality and potentiality related to productivity, industrial establishment, urbanisation and energy production need to be seriously considered to match up the demands getting accumulated.
- Pollution generated by solid waste, sewage, hazardous waste, toxic chemicals etc. have developed enormously due to lack of management and accentuated with urban/industrial growth. Signals being received from these issues are to be deemed as warning to resolve the issues urgently.
- Agriculture, land use, irrigation, along with land conservation and rehabilitation need to be reviewed at the policy and institutional level to enlarge food security for the people to (i) upgrade national productivity, (ii) alleviate poverty, and, (iii) to minimise migrational upsurges.
- Energy, transport, industrialisation and economic development are interconnected segments requiring balanced growth; and Nepal needs to concentrate all the available resources to further up exercises connected thereto.

SECTION 3 : Strengthening the Role of Major Groups

- The role of scientific and technological community has not been as yet realised in practice. The programme related to improving communication/cooperation and in promoting code of practice would be the major nuclei in enhancing the growth of science and technology towards promoting vital support to sustainability.
- To reach to the indigenous people for enlarging their concern in sustainable development there are needs of elaborate exercises at various stages. Theoretically it sounds simple but it is hard to work out. So is about strengthening the role of the farmers and promoting the initiatives of local authorities. Instruments at the decision making level, institutional behaviour and functioning at the local level towards promoting skill and organisational setting need to be commissioned for painful undertakings. And, for all these generative pursuits Nepal needs regional and international inputs massively for a long duration in dynamic and expressive undertakings.
- The role of women, children/youth and NGOs is in general focuss; problems and issues in each of these sectors need to be continuously looked into to ensure positive inputs in all these divisions leading them to recognise the values of disciplines and faithfulness in their respective undertakings.
- The role of business and industry is not as yet known and Nepal needs to borrow ideas towards strengthening their contribution.

SECTION 4 : Means of Implementation

- The system of implementation remains as yet to be rigorously exercised to get it regulated in a systematic manner; and towards that, capacity building through international information exchanges and collaborative network of research centres are big tasks which require close cooperation at the national, regional, and international levels for continued undertakings.
- Science for sustainable Development is altogether a new field and Nepal is to be well guided towards vital programmes related to strengthen scientific basis, enhance scientific understanding and improve long term scientific assessment. The intrinsic values of science and technological formulae will be realised in Nepal only decades later after its contributive role is demonstrated to a broader level of the people specially the decision makers.
- Education, public awareness and training need to be periodically examined to assess the vital progress achieved following the outlined objectives. The procedures to date seem to have been mechanised and critical examination and selective inputs would be imperative.
- Development of National Mechanism requiring enhancement of expertise and harmonisation of assistance at the regional level is vital for Nepal. This may be profitably elaborated in consultation to avail profitable inputs in raising international cooperation
- Institutional arrangement to promote cooperation at various levels need to be seriously pursued. It is vital and much more work is to be done in Nepal in stream-lining such an arrangement towards developing institutional mechanism, capabilities and systematic pursuits.

- Building up and sorting out usable traditional information for decision making are new chapters for Nepal requiring elaborate exercises. This programme can be deemed vital as the efficiency and competence of decision making may be enhanced progressively and effectively through appropriately identified procedures and undertakings.

Programme referable to Nepal

In view of the comments made under section 1-4 of Agenda 21, a package of programme activities aiming sustainable development is very much referable to Nepal. The concept built up today on sustainable development may be further elaborated through specific programme activities in reference; the policies will have to be evolved through reviewing and orientation as and when the issues and implementation proceedings are scrutinised to investigate the factors impeding the performances. The issues identified today may be analysed in multi-sectoral as well as developmental context. And these will have to be enshaped in regional reference as well. Nepal shares the natural resources of the Indian sub-continent; and she has been realising the productive role of the region in resource development for the decades past by calling on the development of water resources as well as by persuasively hosting the International Centre for Integrated Mountain Development in Nepal.

CHAPTER 22

Prospect for the 21st Century : A Regional Perspective

Macro-Ecoprovince

In pursuit of thinking globally and acting locally the nations of the region in reference, are to merge conceptually to build up regional framework of macro ecoprovince to orient our approach and considerations to the issues in conformity to the laws of Nature and inter-relative dependence of the successive eco-provinces while addressing to the issues, challenges and concern of the people at large of the region. In such effortful exercises narrowness of understanding in political and bureaucratic enclaves will have to adopt ample reconciliative postures in combating environmental degradation, enlarging resource potentialities and promoting quality of life of the populations in the mountainous as well as lowland provinces. The nature of work which may be essentially specified should be on watershed management, protected areas, forest management, conservation farming and development of pastures. Tourism is a single enterprise demanding holistic attention in consideration of the carrying capacity of the area in reference, as well as in context of the interconnected potentiality of the region— observing well-regulated environmental discipline in the use of the meagre resources and in raising economic productivity in favour of the people pursuing these undertakings. It has well been gleaned in various nature of analytical pursuits that social, cultural and economic factors influence the programmes of major undertaking; as such, some of these major elements of dynamic potentialities need to be inter-woven in its natural fabrics to play relevant role with positive inputs in implementing the undertakings. Communication network, market planning in view of the hinterland, circulation of economic productivity of the geographical provinces, promotion of cultural linkages and recognition of social institutions in operating project activities of environmental concern and economic benefits, are some of the topics requiring immediate attention. Experiences of work in similar undertakings while being exchanged there is saving of time and scarce resource; apart from that the quality of prescribed approach becomes more productive and economical, promoting the pace of critical evaluation towards achieving the target with pronounced efficiency.

Mutual consultation and collaborative efforts may be advised to certain projects for joint undertaking as well as to considerations for supplementing programs than repeating projects for similar achievements. Such a joint work at the sub-regional or regional level may be helpful in developing cohesive interdependence and faithful commitments towards envisaging challenges without resorting to salvages often provided by the developed frontiers. The achievements thus raised may intensify the confidence within to promote moral strength and discretionary capabilities in enshaping integrated personality which is often lacking in the developing world.

Institutional Network

Policy formulations, enactments, planning, field observations, organisational settings, investigational pursuits, monitoring and evaluation of programme activities need continued support of the institutions for systematic applications. It is vital in the long run. Towards expanding efficiency and utility of the institutes laboriously built up in the decades past, essential working relationship of the relevant institutes at the government, non-government or private levels, are to be sought by possible efforts for establishing a network for participation, exchanges and investigational undertakings. Exchange of available expertise, technical meetings, and workshop in pursuits of investigational undertakings may be adopted as the routine process of institutional functioning at the sub-regional/regional level in an open environment of both academic and professional exercises. Centres functioning with bilateral

and multi-lateral support may as well be prepared to be open and receptive to such exchanges with the expressive objective of receiving assimilative inputs. There are a lot of research centres built-up in the highland terrain as well as establishments of repute at the lowland provinces which are engaged either to environmental issues or major topics referable to the multi-sectoral interrelationships; such nuclei of extended activities of multi-dimensional frontier come to the orbit of concern periodically while matching the peculiar nature of goal being sought. It is thus urgent that preparedness to join such a network be laboriously made by the emerging centres, creating required openings for occasional consultations and even for combined exercises, whenever deemed beneficial towards promoting the quality and volume of meaningful performances.

Integrated Centre for Regeneration

The resource base of South Asia is seated in the Himalayan region. The area in reference may be delineated to encompass the mountain area from the Pamir region adjoining the Karakoram Hindukush-Zaskar ranges in the west-north-west, the Tibetan plateau at the centre bordered by the Kunlun Shan in the north, and the Heng Tuan Shan in the east, and by the Great Himalayan Range in the south. In this perennially cold region, the locale of the three peaks : the Everest, the Lhotse and the Nuptse resemble the environment of a Pole; and, the Himalayan region resembles the Arctic and the Antarctic. Known as the roof of the world, the region extends through several countries of Asia. The extremely high altitude of Himalaya provides a unique glacial climate and the primary atmospheric processes operating there affect the regional and global weather (Bahadur 1992 p. 183). An integrated research centre of this region will be very much precious and beneficial in terms of: (i) land-atmospheric interaction revealing basic understanding of climate dynamics; (ii) determination of the energy and water balance of high altitude lakes; (iii) forecasting of melt water contribution from snow and ice to stream flow; (iv) measurement of rates of erosion and siltation; (v) evaluation of the rate of mountain uplift and associated seismicity; (vi) characterisation of floral and faunal distribution and their ecological significance; and, (vii) understanding various atmospheric processes operating at different temporal scales which influence moonsoonal circulation.

The integration of such scientific efforts will in the decades to come, evolve an appropriate set of technologies for regeneration of the South Asian region which presently is – under great stress of decay and degradation. It may be proposed that research groups covering different scientific disciplines be established and nurtured in all the institutes of higher learning and government organisations supported by High Level National Coordinating Committees of the countries in the region. A High Level Standing Agency may be commissioned by the nations of the region to overview the research work of multi-disciplinary groups and to seek involvement of international scientists and research agencies so far engaged in the region, towards developing a pool of experts as well as equip laboratories required for such a mighty task with possible provision of international assistances. The research findings may be collated with the observations made in other parts of the globe : (i) Andean region (ii) European Alps; and (iii) Humid Tropical Ecosystem of South-East Asia. In such an effort the UNESCO Paris could be the operable channel.

This kind of structural setting for researches, institutional network and adaptations of macro-ecoprovince related understanding, will initiate investigational dynamics for sustainable development in all the counters towards enhancing knowledge of the potential resources of Asia and their appropriate use, building up unanimity of opinion in the region regarding prioritisation of programme and maximum use of the regional talent, and to discuss region's cooperative attitude for the global cause.

Nepal Macro Economic Indicators, As of 1990

GNP per capita (US\$)	170
Average annual growth rate of GNP per capita (1965-90)	0.5
Population (millions)	19
Average annual growth rate of population (1989-90)	2.6
Life expectancy birth (years)	52
Adult illiteracy	74
Average annual growth rate of GDP (1980-90)	4.6
Distribution of gross domestic product (in percent)	
Agriculture	60
Industry	14
(Manufacturing)	5
Services	26
Average index of food production per capita (1979-81 = 100) (1988-90)	115
Energy consumption per capita (kgs. of oil equivalent)	25
Total expenditure as percent of GNP	20.4
Over all deficit as percent of GNP	- 8.1
Total revenue as percent of GNP	10
Exports (millions of dollars)	162
Imports (millions of dollars)	543
Total external debt (millions of dollars)	1621
Total external debt as percent of GNP	53
Total debt service as a percentage of export of goods and services	18.2
Average structure of population (percent)	
0-14	42
15-64	54.9
Crude birth rate per 1000	40
Crude death rate per 1000	14
Total fertility rate	5.7
Population per physician	25,000
Infant mortality per 1000	121
Daily calorie supply (per capita)	2077
Primary enrolment in education (in percent of age group)	86
Urban population as percent of total	10
Forests area (thousand of sq. kms)	21
Annual deforestation (thousand of sq. kms)	0.8

Source : World Development Report, 1992.

Nepal Macro Economic Indicators, As of 1990

GNP per capita (US\$)	170
Average annual growth rate of GNP per capita (1965-90)	0.5
Population (millions)	19
Average annual growth rate of population (1989-90)	2.6
Life expectancy birth (years)	52
Adult illiteracy	74
Average annual growth rate of GDP (1980-90)	4.6
Distribution of gross domestic product (in percent)	
Agriculture	60
Industry	14
(Manufacturing)	5
Services	26
Average index of food production per capita (1979-81 = 100) (1988-90)	115
Energy consumption per capita (kgs. of oil equivalent)	25
Total expenditure as percent of GNP	20.4
Over all deficit as percent of GNP	- 8.1
Total revenue as percent of GNP	10
Exports (millions of dollars)	162
Imports (millions of dollars)	543
Total external debt (millions of dollars)	1621
Total external debt as percent of GNP	53
Total debt service as a percentage of export of goods and services	18.2
Average structure of population (percent)	
0-14	42
15-64	54.9
Crude birth rate per 1000	40
Crude death rate per 1000	14
Total fertility rate	5.7
Population per physician	25,000
Infant mortality per 1000	121
Daily calorie supply (per capita)	2077
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Source : World Development Report, 1992.

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