Framework Contract AMS/451 Lot N°6
Request for Services N°2005/102913 – Version 2

Country Environment Profiles

of Bhutan, Maldives, Nepal and Sri Lanka

Country Environment Profile of Nepal

Final Report

October 2005

This project is funded
by the European Union

A project implemented
by MWH

This report is financed by the European Commission and is presented by Dr Russell C. Frost for the Government of Nepal. It does not necessarily reflect the opinion of the Government of Nepal or the European Commission.

INDEX P.

ABBREVIATIONS

1. SUMMARY

The CEP of Nepal addresses the following objectives: (i) to identify and assess environmental issues to be considered in the preparation of a Country Strategy Paper (ii) provide information on key environmental challenges and policies, strategies and programmes designed to address them (iii) establish key linkages between environment and poverty reduction (iv) provide an important source of baseline information.

Chapter 2 reviews the physical and biological environments, identifies and analyses key issues, considers their interactions with poverty and outlines some 22 potential responses. More than fifty indicators that may be used to track progress in the identified environmental-ecological issues are identified. Poverty is pervasive, averaging about 40% across the country with still higher levels in the predominantly rural population. Rural poverty is associated with low life expectancies, low educational opportunity and achievement and with the following key environmental and health issues: unsanitary household conditions and inadequate access to wholesome water (diarrhoea), lack of electricity, indoor air pollution resulting from the use of solid fuels (wood and crop residues) for cooking and heating (respiratory disease), deforestation, reduction in biodiversity and wildlife numbers resulting from land encroachment and poaching, and the misuse of agricultural chemicals (pesticides and fertiliser). A high population growth rate adds to pressures on the environment and poverty.

Sustained poverty, coupled with the attraction of greater economic opportunities elsewhere and the desire to escape from the worst consequences of the insurgency, has triggered a substantial and continuing migration from rural to urban areas of Nepal. Coupled with legislative, financial and other institutional weaknesses affecting urban and industrial environmental management, the resulting rapid urban population growth has caused severe urban environmental degradation - especially in Kathmandu Valley. Water supply, air quality, solid and clinical wastes management, river water and groundwater quality, road traffic congestion have all been adversely affected.

Natural geological, topographic and climatic factors coupled with the effects of climate change (past and expected) place Nepal at high risk from earthquake, flooding and landslides. The potential for a major human and economic disaster afflicting Nepal exists through the risk of earthquake in the highly urbanised Kathmandu Valley.

Chapter 3 reviews the environmental policy, legislative framework and institutional capacities, to the extent possible, and analyses the integration of environmental concerns into the main sectors. Environmental policy and legislation are fairly embryonic but cover project environmental impact assessment (EIA), industrial pollution control certification of operating factories, effluent discharge limits, ambient air quality and vehicular emissions. Though policy and legislation are reasonable, so far as they go, their enforcement is weak, primarily due to the lack of an environmental agency or inspectorate charged with monitoring and enforcement responsibilities. Institutional capacity for environmental policy making and environmental management is rather weak, partly through a lack of financial and other resources, partly through an institutional culture which tends to (a) compartmentalise policy making and planning and (b) enforce officials' mobility (thereby diminishing their technical capability and reducing their incentive to learn) and partly through there being no environmental agency (providing expert advice and knowledge).

There are also significant legislative gaps, the more important of which are considered to be (i) a lack of requirement to undertake strategic environmental assessment (SEA) of policies, programmes and plans (ii) no quantitative limits on emissions to air from industry (iii) very limited regulatory guidance on minimum acceptable technology standards for industrial production and pollution abatement

(iv) no surface water quality standards and no system of river catchment planning (v) no detailed regulations, standards and environmental safeguards regarding solid and hazardous (including clinical) wastes management and (vi) no system of land-use planning to coordinate development with environmental considerations and other factors. These gaps link with an analysis of the environmental concerns in various sectors. Proposals are made regarding legislation and planning to help strengthen the integration of environmental concerns into the transport, industry, wastewater, solid and hazardous (including clinical) wastes sectors.

Chapter 4 reviews briefly the cooperation with Nepal of the EU and other donors and agencies having an environmental perspective. There are many multinational, bilateral and partner initiatives in support of Nepal – in poverty alleviation, economic support and governance especially but also in more specific fields such as the environment and conservation. It must be very difficult indeed for HMGN to coordinate this activity so as to minimise overlap and maximise the benefits to Nepal. The challenge for the EU in a Country Strategy Paper will be to identify and agree value-added initiatives with HMGN (or local NGOs).

Chapter 5 addresses this issue further, proposing a number of initiatives which the EU might pursue, though much work would have to de done to develop and agree modalities. All are compatible with Nepal's sustainable development agenda. In the absence of cost-benefit analysis to inform decision making, priorities depend substantially on whether it is regarded more important to address environmental issues affecting the immediate concerns of the poor in rural areas or structural, longer term environmental management issues which perhaps currently have greater impact on urban areas. However, both aspects are important for long-term sustainable development: they are not mutually exclusive but supportive. Comparing these tangible issues with minimising the risk of earthquake induced disaster in Kathmandu adds to the complexity of priority assignment. And, of course, the opportunities and possibilities for intervention also have to be examined. Consequently, the priority suggested below are subjective only and could easily change in the light of more in-depth analysis. Five interventions in each area are suggested in descending rank order (top priority first):

RURAL ENVIRONMENTAL IMPROVEMENT (POVERTY)	ENVIRONMENTAL MANAGEMENT
1. Develop and implement an integrated programme to improve household and nearby environments, with ambitious targets for: sanitation, access to safe water, and technologies to reduce indoor pollution & wood burning	1. Establish a national environmental agency (inspectorate) and develop its institutional capacity for environmental management (air, water, land) and enforcement of legislation
2. Support the development and implementation of an accelerated programme to provide electricity in rural communities and households.	2. Support the introduction of legislation establishing (a) land-use planning (b) strategic environmental assessment (c) rules and standards for wastes management – provide capacity building to support implementation
3. Support the development and implementation of early warning systems, preventive measures and contingency plans for flood and landslide risks in both mountain/hill areas and the Terai plain	3. Support the development and implementation of integrated urban air quality management addressing impacts and control of emissions from traffic, industrial and other sources
4. Support strengthened extension (knowledge and training) programmes to foster proper use of pesticides, herbicides and fertilisers in agriculture.	4. Establish minimum technology standards and pollution abatement guidance for potentially polluting industries and impose associated limits on emissions to air
5. Undermine the economic incentive for poaching by stimulating economic growth in areas adjoining national parks & reserves, partly through fostering a greater participation in and share of the benefits from eco-tourism.	5. Develop a robust plan for minimising the risk of disaster in the event of an earthquake affecting Kathmandu Valley (building codes, contingency plan, and relief).

2. STATE OF THE ENVIRONMENT

2.1. NATURAL PHYSICAL ENVIRONMENT

2.1.1. Physiography

A landlocked country of 147,181 sq. km, Nepal comprises three main physiographic regions – the Terai plain (23% of total land area), the hills (42%) and the mountains (35%) - though HMGN identifies a more detailed sub-division of the hill and mountain areas[1]. Each region lies largely parallel to each other, running the length of the country in a NW-SE direction. Regional characteristics are distinctive and reflected in many of the prevailing environmental and socio-economic conditions.

The Terai lies at an altitude of between 60 and 200 m and represents a northerly margin of the Gangetic Plain extending some 40 km into Nepal. It is traversed by all the major rivers of Nepal - the Karnali, Narayani and Kosi - which form part of the larger Ganges river basin. The Terai contains many wetland areas and is prone to flooding from these rivers during the monsoon period (June to September). Development with very substantial population growth has occurred throughout the Terai plain since malaria was brought under control in the mid-late 1950s.

Between the Terai and the Himalayan mountains lie ranges of hills of ever increasing altitude of up to 4,000 metres above sea level. This area includes a number of Terai-like valleys at an altitude of about 150 m above in the lower hills and a number of broad fertile valleys (previously lakes) surrounded by the mountains - such as Kathmandu Valley and Pokhara. Most river valleys, however, are characteristically steep-sided and V-shaped, cut by glacial-fed river systems draining generally southwards and which swell substantially during seasonal, intense monsoon rainfall. Transport is difficult because of the rugged terrain and the lack of easy transport contributed to the physical isolation of many parts of the country. Over half of the population lies in this hill region which is extensively cultivated amidst extensive forest cover.

Up to the border with China (Tibet), the northernmost mountain region comprises the Himalaya and many of the world's highest mountains of over 8,000 metres altitude, sculpted by glaciers. Terrace cultivation is practised up to a height of about 2,700 m - representing the cloud line. Forest cover extends from this altitude up to the tree line. Approximately 7% of the population lives in this region.

2.1.2. Climate

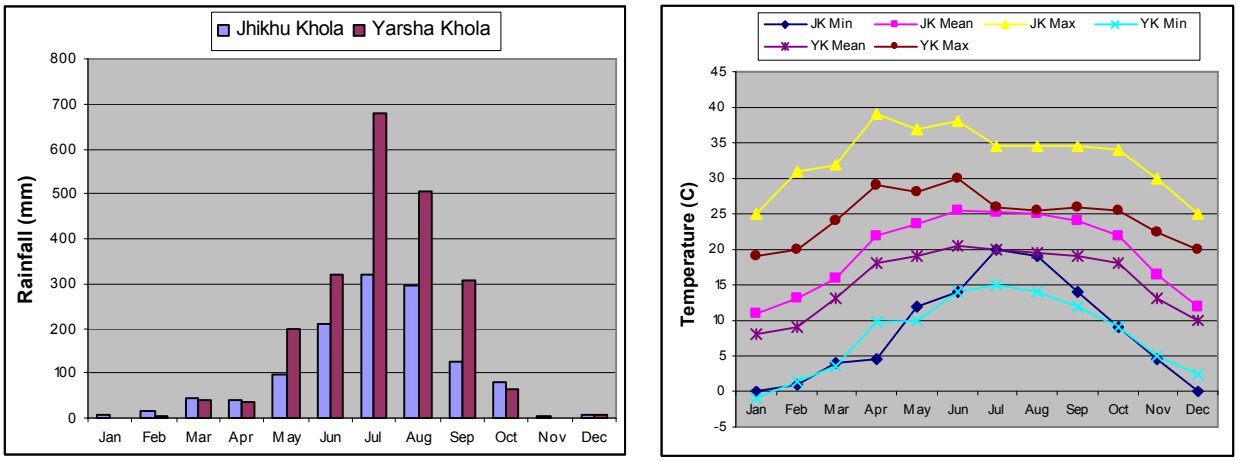
Climatic conditions vary from sub-tropical in the Terai, through warm-temperate in the hills to alpine in the mountains. Most precipitation falls in the monsoon months of June to September, the amount generally decreasing from east to west – with profound implications for agriculture and water availability. As illustration, Figure 2.1 shows seasonal variations in rainfall and temperature for two hill catchments, the Jhikhu Khola and Yarsha Khola located, respectively, 45km and 190 km to the east of Kathmandu[2]. Winter precipitation (mostly as snow) contributes significantly to the annual total in the northwest of the country, playing a major role in mass balance of glaciers in western Nepal and a secondary role in the glaciers of eastern and central Nepal. Precipitation and temperature varies with

[1] HMGN Survey Department and Central Bureau of Statistics (2004), "The Population and Socio-Economic Atlas of Nepal", Map No. 1.3 National Geographic Information Infrastructure Programme (NGIIP) Nepal. http:www.ngiip.gov.np

[2] Merz J et al (2002), "Water and Erosion Studies of PARDYP Nepal – The Water Demand and Supply Survey", ICIMOD Nepal

altitude, the hottest region being the Terai where maximum temperatures can reach 45 C or so (the highest temperature of 46.4 C was recorded at Dhangadhi in the far western Terai, June 1995[3].

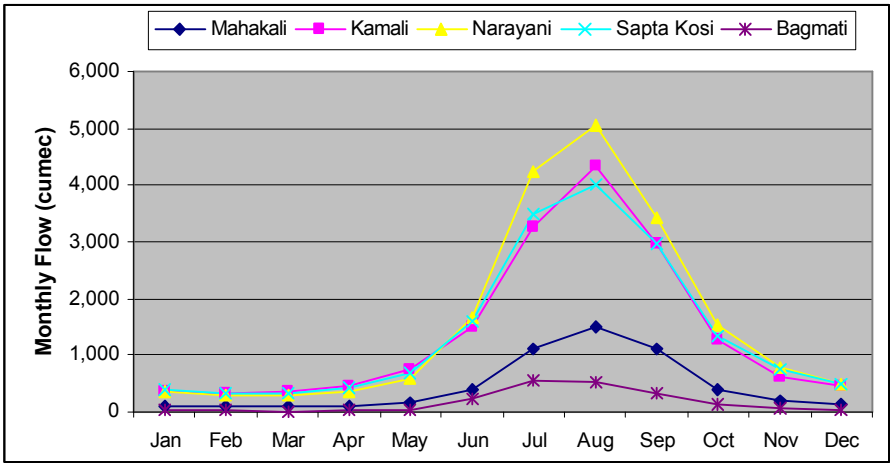
Figure 2.1 Monthly Variations in Rainfall and Temperature of Two Hill Catchments



2.1.3. Hydrology

All rivers in Nepal form part of the larger Ganges Basin. Four major rivers comprise about 90% of the total annual river flow – from the west to east of Nepal: the Mahakali, Karnali, Narayani and Sapta Kosi. They originate in the Himalaya, their base flow of glacial melt water being augmented substantially and rapidly in response to monsoon rainfall in their catchment – see Figure 2.2. Other rivers are relatively minor - the Babai, West Rapti, Bagmati, Kamala, Kankai and Mechi: rising in the hill region and fed by seasonal precipitation and groundwater. The Bagmati River is the largest of these and its flow regime also is shown in Figure 2.2. Appendix 6.4 lists all data (WWF Nepal 2005).

Figure 2.2 Monthly Flows of the Major Nepali Rivers



The swift and substantial base flows of the major rivers combined with the drop in elevation provided by the topography provide a strong basis for Nepal to exploit hydroelectric power to a substantial extent. Existing generating capacity is 650 MW against a feasible potential capacity of 42,000 MW[4].

[3] WWF Nepal Program (March 2005), "An Overview of Glaciers, Glacier Retreat, and Its Subsequent Impacts in the Nepal, India and China".

2.1.4. Groundwater

Substantial groundwater recharge estimated as 5,800 to 11,600 million m^3 per year occurs in the alluvial deposits of the Terai, used extensively in that region as the principal water resource; drinking, cooking, washing and agriculture. Shallow wells are sunk for domestic uses but deeper ones are used for irrigation water. Groundwater extraction in 1996 was estimated as about 685 million m^3 per year, i.e. about 10% of the annual recharge[5]. Water quality testing since 1999 has revealed the significant but sporadic presence of arsenic (As) in excess of WHO and Nepali standards in groundwater drawn from shallow wells in the Terai[6]. Appendix 6.3 summarises. Groundwater is also present in the broad valleys in the hill areas of Nepal, used to supplement surface water resources.

2.1.5. Natural Disaster Risks

Over a 19-year period from 1970-1998 Nepal suffered 54 large-scale disaster events resulting in the death of 10,185 and affecting 7.19 million people. Table 2.3 analyses these events into types. Nepal ranks fifth in the world in terms of its per capita exposure to flooding (UNDP 2004). Three types of flood risks occur: (i) overtopping of river banks by rivers swollen by monsoon rains as they pass through the plains, i.e. the Terai – this is understood to be the major recurring event (ii) flash floods in hilly areas caused by intense rainfall and (iii) glacier lake outburst floods (GLOFs). Every year hundreds of people die in Nepal from the flashfloods and landslides that result from its topography and climate, with damage also to the transport network and agricultural economy[7].

Table 2.3 Large-Scale Disasters in Nepal 1970-1998[8]

EVENT TYPE	NO. OF EVENTS	DEATHS	AFFECTED
Cyclone / hurricane / typhoon	6	97	184
Floods	22	5,806	2,007,000
Drought / famine / food shortage	4	-	4,400,000
Avalanche / landslide	12	882	95,219
Epidemics	7	2,535	56,229
Forest / scrub fires	1	56	50,000
Earthquake	2	809	576,616

Appendix 6.12 lists GLOF events recorded in Nepal and provides a description of the devastation they can cause, as exemplified by the Dig Tsho outburst in August 1985. Since that time the Government has considered GLOFs a development threat and has focused on glacier studies. There are currently 2,315 glacial lakes of various sizes, occupying a total area of 75 sq. km. Twenty six of these including the Imja Tsho, Tsho Rolpa, Lower Barun and Thulagi[9] were identified in a 2001 sur-

[4] Personal communication from Bijaya Man Sherchan, Mailun Khola Hydropower Company Pvt. Ltd 5th July 2005

[5] Shrestha, B.R., Whitney, J.W. and Shrestha, K.B. (Editors), "The State of Arsenic in Nepal-2003". National Arsenic Steering Committee, Environment and Public Health Organisation, Kathmandu, Nepal, pp 126, January 2004.

[6] The source of the arsenic is thought to be natural, geologic in origin, but the processes whereby it is mobilised in groundwater are poorly understood – Shrestha et al (2004).

[7] HMGN (2004), "Sustainable Development Agenda for Nepal".

[8] UNDP Bureau of Crisis Prevention and Recovery (2001), "Disaster Profiles of Least Developed Countries"

[9] The Imja Tsho did not exist before the 1950s; a few small ponds started forming in 1955-63; a 1992 survey showed the lake was 1.3km by 0.5km, had an average depth of 47m, covered an area 0.60 km^2 and its volume was estimated as 28 million m^3; A survey in 2002 showed the lake area had expanded by 28% to 0.86km^2. The Tsho Rolpa also began as a series of small ponds

vey as potentially dangerous. Major risk factors are: rapid growth rate of the lake, rapid degradation of terminal and lateral moraines holding the lake water, melting of fossil ice inside the moraine, seepage of lake water through the end moraine and rapid ice calving from the glacier terminus. Only at Tsho Rolpa has there been some mitigation work and an early warning scheme implemented.

The UNDP assessment of disaster risk considers events in the past 19 years only, and assesses risk based on the cumulative number of people affected. However, this approach may give a spurious indication of risk for extreme events such as a major earthquake, which are of infrequent occurrence, and whose effects depend on location and preparedness (in terms of building design, contingency planning etc). What also needs to be considered is (i) the risk of a major earthquake occurring and (ii) the probable consequences should an earthquake happen.

Lying as it does on the edge of the Himalaya, Nepal has a high risk of earthquake – expecting strong earthquakes once or twice per century[10] - and tremors are a constant occurrence. For example, Kathmandu Valley experienced a major earthquake in 1934, affecting many historic buildings in Bhaktapur. The consequences of a major earthquake in Kathmandu Valley now, or at some time in the future, could be much more substantial. The Valley is highly urbanised with most buildings made of brick and concrete and few designed to be earthquake resistant. Government recognises that "(Nepal's) preparation for a large earthquake is poor," and HMGN policy as set out in its Sustainable Development Agenda invokes improved buildings design and construction, early warning systems and contingency measures.

2.2. BIOLOGICAL ENVIRONMENT - BIODIVERSITY

Nepal's diverse physiographic and climatic regions, coupled to its historic isolation, gives rise to a rich ecological diversity: from the rocky alpine habitat of the snow leopard (3,000 to 5,400 m altitude) through to the Terai plains, wetlands and forests, natural home to several flagship large mammals. Key ecological features are introduced below.

2.2.1. Forests, Wetlands and Grasslands

Much of Nepal's land surface is still covered by forests though deforestation has been significant. The latest full assessment of forest status was made some time ago in 1994, indicating that forest and shrub cover equalled 29% and 10.6% of total land area, respectively. This compares with forest and shrub cover in 1978 of 38% and 4.7%, respectively. Some 118 forest ecosystem types are found in Nepal, including the eastern Himalayan broadleaf and conifer and western Himalayan temperate forests. Within the forests are found 9.3% and 4.5% of the world's bird and mammal species, respectively. Much of the rural population, the poorest especially, also depend on a rich variety of forest products to augment their livelihoods through consumption and trade e.g. wood for fuel and making tools, implements, homes and furniture, fruits, nuts, fish, insects, roots, medicinal plants, grasses reeds and leaves for thatch, mats, baskets, wrapping and fodder, and leaf litter for fertiliser etc[11]. Community participation programs are reported to have proved very successful in achieving sustainable forest management.

in the 1950s and is now the largest glacier lake in Nepal at 1.76km^2 – see Appendix 6.12 - and the risk of a GLOF is regarded as high.

[10] HMGN (2003), "Sustainable Development Agenda for Nepal", p. 24.

[11] HMGN National Planning Commission and Ministry of Population and Environment (2003), "Sustainable Development Agenda for Nepal",

Natural grasslands cover approximately 14% of Nepal and are important areas in terms of biodiversity and sources of forage for wild ungulates and domestic livestock. In the Terai plains natural grasslands occur along flood plains and terraces but, as a result of increasing population pressure, they only occur in their natural state within protected areas. At higher altitudes, trans-Himalayan and alpine grasslands are home to a diverse array of wildlife and are grazed by livestock, which form an integral part of the livelihood of several different ethnic groups. While there is a general assumption that these high elevation areas are being overgrazed, relatively little is known about the ecology and sustainability of prevailing land practices (Richard et al, 2000).

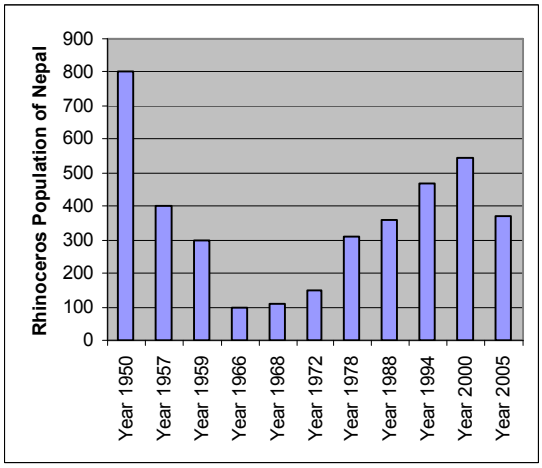
Wetland areas provide habitat for several species of wildlife and lie within various ecosystems of both the high mountains and lowland plains of the Terai. The wetlands of the Terai alone support 32 species of mammal, 461 bird species of which 15 are rare, 9 species of turtle, 20 snake species and 28 fish species.

2.2.2. Fauna and Flora

Nepal is home to four of the most endangered mammal species in the world:

- Royal Bengal Tiger – a Terai population in 1999-2000 of about 340-350 including 125 breeding tigers, up from a total population of less than 100 tigers in the 1970s
- Greater one-horned Rhinoceros – a Terai population of about 544 in 2000, including 87 transplanted to form two population centres, but declining through poaching to 372 in 2005, see below
- Asiatic Elephant – a Terai population of about 120
- Snow Leopard – estimated at between 300 and 500 in Nepali districts of the Himalaya.

A total of 861 bird species have been recorded in Nepal, over 8% of the world total, but 133 (15%) are considered threatened and 72 of these are thought to be critically threatened or endangered[12]. Seventy eight of the threatened species inhabit the forested areas – at risk from both forest losses and deterioration, principally in the tropical, sub-tropical and lower temperate zones. The remaining threatened species mostly inhabit wetlands (44) - almost two thirds of wetland birds are considered critically threatened or endangered; grasslands (17); scrub (3) and open country (6).



Many communities in Nepal have traditionally depended on plants for their medicinal properties and HMGN has implemented a National Biodiversity Strategy (NBS) which seeks to place conservation of medicinal and aromatic plants at the heart of its conservation efforts. The number of medicinal and aromatic plant species in Nepal has been placed between 700 and 1,600 though an updated and revised National Register lists 187 species (IUCN 2004).

[12] Baral, H.S. and Inskipp, C. (2004), "The State of Nepal's Birds 2004", Department of National Parks and Wildlife Conservation, Bird Conservation Nepal and IUCN-Nepal, Kathmandu. (p. 9)

2.2.3. Pressures on the Biological Environment

Climate change (see 2.7.2) is a long-term potential threat to current eco-systems and biodiversity. But the principal immediate pressure on the biological environment is human activity and population growth (see 2.3). This may result for example in deforestation or forest degradation when trees are cut unsustainably for timber and firewood, cleared by slash and burn techniques for agricultural or grazed uncontrollably by livestock animals. In addition to population growth, root causes include low agricultural productivity, small land holdings and the struggle for land, lack of off-farm livelihood opportunities, inadequate access to and management of forest resources, and cross-border issues. Similar encroachment reduces the areas of grassland and wetland habitats frequented by wildlife.

In turn, the extension of cultivated land coupled with diminished forest, grassland and wetland cover, (i) reduces the area of habitat available to wildlife[13] (ii) reduces or eliminates corridors between habitats, which *in extremis* result in isolated habitats whose populations become increasingly vulnerable to factors such as fire and climate change (iii) proximity to man results in species being threatened by hunting and trapping and, indirectly, by overfishing (iv) bird poisoning by diclofenac, a drug used to treat livestock ailments has been identified as responsible for the plummeting numbers of White-rumped vulture (*Gyps bengalensis*) and Slender billed vulture (*Gyps tenuirostris*) which were both common and widespread in Nepal only 10 years ago and (v) potentially results in conflict between the rural (farming) residents and wildlife if and when wildlife stray outside the protected areas. The last of these factors can result in revenge killing – of snow leopards, for example – if domestic animals are taken or crops destroyed. To help offset this, National Parks seek to provide payments to neighbouring communities so that they can share in the economic benefits such parks can bring.

Efforts to conserve and expand the rhinoceros population in protected areas of the Terai were successful up to 2000, but indirectly the insurgency has had a major adverse impact since then through increased poaching. Since 2001 the number of army patrol posts has been reduced from 32 to 7, and the weaker security has allowed local poachers easier access. At least 94 rhinoceroses have been killed for horns in the past five years, 10 between March and June 2005[14], the gang of local (poor) poachers maybe receiving US$200-300 for a horn that fetches some $30,000-50,000 in the ultimate markets of East Asia. Tigers similarly are poached by the poor, the skins being transported to the Tibetan market and the bones to China for traditional “medicines” etc. It is understood that security and management personnel have been upgraded at Royal Chitwan NP recently.

2.3. SOCIO-ECONOMIC CONDITIONS

2.3.1. Demography

Nepal has a young and growing population, projected to increase by 2.0% per year to 34.2 million by 2021, an increase of about 48% over the 2001 census total - see Figures 2.3 and 2.4[15]. Most people live in the hill and Terai regions with average population densities (people per sq. km) in 2001 lying in the ranges 168-454 in the Terai; 50-300 in the mid-mountain zone including a high of 2,379 in Kathmandu District (of 395 sq. km); and 4-38 in the Himalayan zone. The population is predomi-

[13] Even the area of the Royal Chitwan NP, for example, has been reduced by 60% from its original size.

[14] The Kathmandu Post, 13th July 2005, p.1

[15] HMGN Survey Department and Central Bureau of Statistics (2004), “The Population and Socio-Economic Atlas of Nepal”, National Geographic Information Infrastructure Programme (NGIIP) http://www.ngiip.gov.np

nantly rural, the 2001 census recording a rural-to-urban population ratio of 86:14 though some recent estimates suggest the urban:rural population ratio might have increased to 20:80.

Figure 2.3 Approximate National Population Composition by Sex and Age Group, 2001

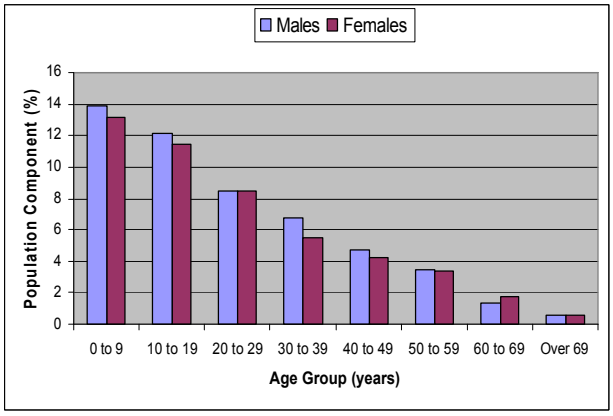
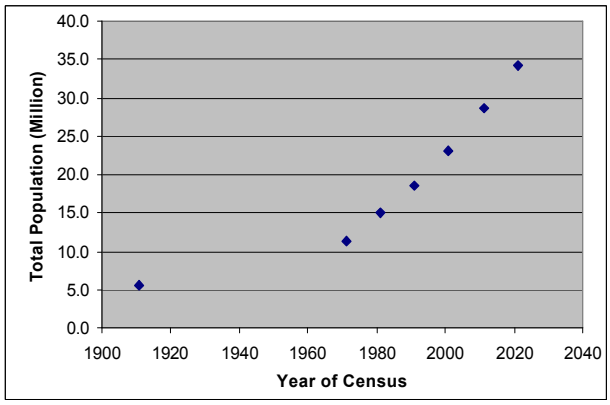


Figure 2.4 Past and Projected Growth of Nepali Population 1911-2021



These population figures incorporate the migration of Nepalis to other countries, primarily (2001 census data) India (77.3%) and various Gulf States (14.5%). Approximately 3.4% of the Nepali population was reported absent from Nepal at the time of the 2001 census: remittances from those who've migrated for economic reasons provide a substantial demand injection into the Nepali economy[16], contributing to a construction boom in urban areas especially in the Kathmandu Valley.

The rate of urban population growth is expected to be significantly higher than the national average, reflecting organic growth and especially migration from the rural areas to escape from (i) poverty and the lack of economic opportunity and (ii) from the worst effects of the ongoing insurgency. It is expected that all existing urban areas will grow and that new ones may form and develop in the rural areas: i.e. urbanisation pressures will not be confined to Kathmandu Valley, though a population growth of 72% in the Kathmandu Valley from 2001 and 2021 is projected[17] and even this may be an underestimate.

These population figures incorporate the migration of Nepalis to other countries, primarily (2001 census data) India (77.3%) and various Gulf States (14.5%). Approximately 3.4% of the Nepali population was reported absent from Nepal at the time of the 2001 census: remittances from those who've migrated for economic reasons provide a substantial demand injection into the Nepali economy[18], contributing to a construction boom in urban areas especially in the Kathmandu Valley.

The rate of urban population growth is expected to be significantly higher than the national average, reflecting organic growth and especially migration from the rural areas to escape from (i) poverty and the lack of economic opportunity and (ii) from the worst effects of the ongoing insurgency. It is expected that all existing urban areas will grow and that new ones may form and develop in the rural areas: i.e. urbanisation pressures will not be confined to Kathmandu Valley, though a population

[16] Remittances, including those through unofficial channels, reached $820 million in FY2003, equivalent to about 14% of GDP. Asian Development Bank (2004) Country Strategy and Program, Nepal 2005-2009. Personal communications from several sources suggest this may be a considerable underestimate of the true level of remittances.

[17] Ibid

[18] Remittances, including those through unofficial channels, reached $820 million in FY2003, equivalent to about 14% of GDP. Asian Development Bank (2004) Country Strategy and Program, Nepal 2005-2009. Personal communications from several sources suggest this may be a considerable underestimate of the true level of remittances.

growth of 72% in the Kathmandu Valley from 2001 and 2021 is projected[19] and even this may be an underestimate.

Appendix 6.5 analyses how demographic factors may affect the environment and environmental health – both factors interacting extensively and intimately with the socio-economic issues noted in 2.3.2 and 2.3.3. Key issues identified are:

- Increased pressure on the rural environment driven by (i) the needs of pro-poor growth to increase agricultural productivity (beyond population growth) and access to markets and (ii) more extensive use of natural resources to meet the needs of an expanded rural population
- Increased urbanisation resulting from organic population growth, economic migration and escape from conflict with, potentially causing (i) further environmental degradation[20] and (ii) an increased risk of disaster resulting from a major earthquake affecting urban areas
- Increased pressure on wildlife numbers and biodiversity as reserves and corridors become increasingly enclosed.

2.3.2. The Maoist Insurgency

Drawing on chronic and deep-seated rural poverty, social exclusion and governance failures, the Communist Party of Nepal (Maoist) launched a 'Peoples War' in February 1996. The insurgency continues, claiming the lives of at least 10,000 people and having many other adverse effects such as the:

- Disruption of rural livelihoods
- Displacement of 300,000-400,000 rural families, causing out-migration in response to killings, extortion, forced recruitment, decreased agricultural production and fear
- Destruction of infrastructure facilities worth about $400 million
- Restricting the free movement of people and goods, e.g. disrupted by strikes (bandhs) lasting several days[21]
- Plummeting number of tourists and national income from tourism[22]
- An increase in wildlife poaching following the redeployment of army troops from anti-poaching security duties to tracking and fighting the insurgents.

Government control is now limited outside the cities and District headquarters. Recently, it was stated for example that, "The government has no capacity to implement (its) budget as the environment is becoming very tricky day by day. Of the total Rs 32 billion allocated for the development of sector this year (FY04/05), less than Rs 16 billion has been spent"[23]; "the non-agricultural sector has

---

19 Ibid

20 The risk that HIV-AIDS may spread more rapidly and extensively also exists.

21 ADB (2004) Country Strategy and Program, Nepal 2005-2009; and Department for International Development (2004), Nepal Country Assistance Plan – Peace Through Development.

22 Second only to agriculture in terms of employment generation, the Nepali tourism industry grew at between 6% to 10% per year from 1976 to 1999, when there were 491,500 arrivals by air: the numbers have since dropped to between 216,000 to 288,000 over the period 2002-04 – source: Himalayan Times (12 July 2005). Relative to the same (10-month) period, foreign currency earnings from tourism have fallen from 18.1 billion Rs in FY03/04 to 6.7 billion Rs in FY04/05 – source Himalayan Times (16 July 2005).

23 Dr Ram Sharan Mahat, former finance minister, at a programme held at the Reporters Club 1 July 2005; cited in The Himalayan Times, Saturday July 2nd, 2005 (p. 11)

been hit hard by conflict and the government has not been able to utilise development expenses in over 13 Districts of the country."[24]

As a further fall-out from the conflict, democratically elected central and local government has lapsed since May and July 2003, respectively. And in February 2005, the multiparty national Government was dissolved, the King assuming executive powers notionally to resolve the conflict. Assessment of reports in the daily (English language) Nepali Press, however, suggests its resolution is no nearer.

At the time of an earlier EC Mission[25], it appeared that the Maoists were very clear about which projects they did and did not support. Each project was examined on a case by case basis at the local level. Projects they did not support were asked to close down and the staff to leave the area. If they did not, the project buildings were looted and torched. The Mission reported that the Maoists were more interested in infrastructure based projects, i.e. those projects which provided development which they are unable to do and not supportive of social development schemes which engaged the people as they (the Maoists) wished to be in charge of social and political development. Discussions with a number of agencies and NGOs in Kathmandu, July 2005, suggests that projects and programmes undertaken by donors in partnership directly with local communities and NGOs have a good chance of successful implementation provided that interventions are clearly aimed at delivering improvements in welfare, and are transparent in terms of budgets and payments.

2.3.3. Socio-Economic Conditions

Taking the poverty line as a per capita income of Rs 4,400 a year, about 40-42% of households in Nepal live in poverty: ranging from 23% in urban areas (but less than 4% in the Kathmandu Valley) to 44% in rural areas, though even this latter figure hides poverty hotspots of 55% in the mountain areas and up to 70% in more remote mid- and far-western Districts[26]. Across the country as a whole, average per capita GDP at purchasing power parity (PPP) was US$1,370 in 2002, making it one of the poorest countries in Asia: Nepal lay 140th of 177 ranked countries on the Human Development Index maintained by UNDP[27].

Such poverty levels appear to have been sustained since 1975-76 at least[28]. Though there has been significant real GDP growth, averaging 3.6% to 4.9% p.a. since the early 1990s to 2001-02 despite the insurgency[29], it has not been pro-poor. Specifically it has not improved average living standards in the rural areas, where population growth (2.25%) has matched, and cancelled out the gains from, economic growth (2.3%) over the past 12 years[30]. Though the fraction of the population that is desperately poor may have altered little over this period, population growth has resulted in a greater absolute number of people falling into this category.

---

[24] Ibid, at the same meeting - Dr Shankar Sharma, vice chairman of the National Planning Commission (NPC)

[25] Hollants J, Looke V and Philipson L (2002, January) Report of the EC Conflict Prevention Assessment Mission – Nepal"

[26] World Bank Group, Nepal Country Assistance Strategy 2004 – 2007. These figures are based on the 1995-96 Household Survey data: updated information from the Nepal Living Standards Survey (NLSS) launched in 2003 is expected to be available in 2005.

[27] United Nations Development Programme, Human Development Report 2004: Data hdr_dat_42791489. Only Tajikistan of reporting Asian countries had a lower per capita GDP. Note that the appropriate GDP figures to use when comparing national incomes is that which corrects for purchasing power parity (PPP): for Nepal this results in a significantly higher income level (US$1,370) than cited in the ToR (€230) though this doesn't detract from the conclusion that many Nepalis are afflicted by extreme poverty.

[28] HMGN, National Planning Commission (May, 2003), "The Tenth Plan – Poverty Reduction Strategy Paper 2002 - 2007", p. 24

[29] A reduction in GDP of 8-10% resulting from the insurgency has been estimated: World Bank Nepal CAS 2004 - 2007, p. 9

[30] HMGN, "The Tenth Plan – Poverty Reduction Strategy Paper 2002 - 2007", pp. 30-31. Over the same 12-year period, real GDP growth has averaged 6.0 % in urban areas - focused on Kathmandu Valley.

Numerous social indicators reinforce this picture of poverty, the significant divide between rural and urban areas, and disadvantages based on gender, caste and ethnicity. As an example, Table 2.6 gives recent data on life expectancy at birth and adult literacy for different regions of Nepal[31]: some progress is evident, achieved through Government initiatives with assistance from the international development and donor community.

HMGN's poverty reduction strategy[32] (PRS, 10th National Plan 2002-2007) is based on the four pillars of: (i) sustained high and broad-based economic growth focusing particularly on the rural economy (ii) accelerating human development through renewed emphasis on effective delivery of basic social services and economic infrastructure (iii) ensuring social and economic inclusion of the poor, marginalised groups and less developed regions and (iv) vigorously pursuing good governance as a means of delivering better development results and ensuring social and economic justice. Specific overall and contributory PRS targets for achievement by the end of FY06/07[33] include:

- Reducing the overall poverty level to 30%
- Increasing real GDP growth rate to 6.2% p.a.
- Reducing the overall population growth rate from 2.25% to 2.1%
- Increasing the overall adult (>15 years) literacy rate to 63%
  - Increasing adult female literacy rate from 35.6% to 55.0%
- Increasing life expectancy at birth to 65 years
  - Decreasing maternal mortality rate from 415 to 300 per 100,000 live births
  - Increasing provision of obstetric services by trained personnel from 13% to 18%
  - Reducing infant mortality rate from 64.2 to 45.0 per 1,000
- Increasing the proportion of the population having access to (safe) drinking water to 85%
- Increasing the proportion of the population having access to electricity to 55%
- Increasing the irrigated area from 1.12 million to 1.42 million hectares
- Increasing the number of Districts with access to roads from 60 to 70, and increasing the provision of roads in agricultural and rural areas to 10,000 km

Table 2.6 Variations and Changes in Life Expectancy and Adult Literacy Values

Region or Zone	Male Life Expectancy (y)		Female Life Expectancy (y)		Adult (>15y) Male Literacy (%)		Adult (>15y) Female Literacy (%)	
	1996	2000	1996	2000	1996	2000	1996	2000
Mountain	52.7	48.6	50.4	51.1	44.2	61.9	11.8	26.6
Hill	58.0	65.4	55.5	64.7	58.4	72.3	24.3	39.5
Terai	59.5	61.7	57.0	63.2	52.3	60.2	19.9	32.5
Urban	63.2	71.4	60.3	70.8	76.7	81.2	51.5	56.9
Rural	53.7	58.2	51.3	59.3	52.0	63.6	19.5	32.3
Nepal	**55.0**	**59.3**	**52.4**	**59.8**	**54.3**	**65.8**	**21.3**	**35.4**

[31] HMGN Poverty Reduction Strategy Paper (2002-2007), Table 7

[32] HMGN, National Planning Commission (May, 2003), "The Tenth Plan – Poverty Reduction Strategy Paper 2002 - 2007"

[33] The PRS adopts a normal case scenario (figures given in the text) and a more conservative, financially constrained lower case with less ambitious targets

2.3.4. Environmental Health Indicators

Two major environmental health issues related to socio-economic conditions are the incidence of: (i) diarrhoea, associated with poor sanitation (ii) acute respiratory infection associated with air pollution.

a) Diarrhoea, Water Supply and Sanitation

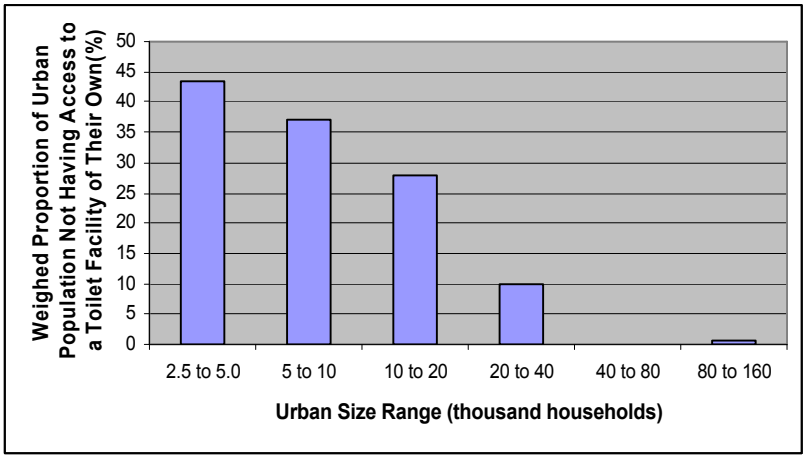
About 15,000 children (under five year's age) die annually from the effects of diarrhoea related disease in Nepal – 80% of which is attributed to poor sanitation/water quality[34]. In 2002, the incidence of diarrhoea in children in the two weeks preceding a national survey[35] was reported as 20% on average, with about 22% of cases being taken to a health-care facility or provider. But incidence ranged from 400-594 in Himalayan Districts, 300-399 in the eastern Terai and some areas in the far-western hills, through to lows of 69-99 in Kathmandu valley and some western Terai Districts[36]. The data show a regional variation in diarrhoea and, by extension, lack of water, poor sanitation and inadequate hygiene, focused especially in rural areas. Table 2.7 provides a recent baseline regarding access to water and sanitation facilities.

Table 2.7 Household Access to Water and Toilet Facilities[37]

	NEPAL	RURAL	URBAN	NOTE
MAIN DRINKING WATER SUPPLY				
- Tap/Piped	53.4	51.0	66.0	Highest usage is in the central hills
- Wells	37.7	39.3	29.2	Mostly used in the Terai
- Other	8.9	9.7	4.8	
HOUSEHOLD TOILET FACILITY				
- Modern, flushable	23.0	17.3	53.1	Mostly in the central hills
- Ordinary	23.8	23.6	25.0	Latrine-type toilet
- None	53.2	59.1	21.9	Householders must use forests, fields or communal facility - majority in most areas with the exception of central hills. See also Figure 2.5 for urban non-provision

Ready access to clean water and modern sanitation is obviously weak, especially in the rural areas where most of the very poor live. However, it must be recognised that access to piped water is no guarantee of good quality or service (see 2.5.2). Also, though the non-provision of household toilet facilities is primarily a rural issue it also affects some urban communities. Household toilet provision

Figure 2.5 Lack of Access to Household Toilet Facilities, Urban Areas



[34] Personal communication from Sharad Ahikary, World Health Organisation, Nepal 6th July 2005.

[35] HMGN, Ministry of Health Website

[36] NGIIP

[37] Ibid. Percentages in rural areas calculated by difference on basis of reporting populations in total and in urban areas.

in notionally urban areas[38] generally depends on community size, see Figure 2.5. Given that each household is likely to contain at least 4-5 people, the smallest urban community shown here will have a population in excess of 10,000. People not having a household toilet in such communities might use the fields or communal facilities whose condition is unlikely to be wholesome.

b) Acute Respiratory Infection (ARI) and Air Pollution

ARI follows skin diseases and diarrhoea as the major cause of morbidity in Nepal, with a national incidence of about 29% in children under 5 years of age (2002): ranging from 50-86% in some Districts in the Himalaya and the Terai to lows of 9-17% in Kathmandu Valley (9%) and some Districts in the western Terai and mountains[39]. The incidence of acute respiratory infection can be related to air pollution (see Appendix 6.6 for the indicative health impacts of air pollutants), specifically indoor pollution from burning fuels (see 2.4.2), cramped living conditions, ambient air polluted by emissions from road vehicles and industries such as brick manufacture (see 2.5 and Appendix 6.8) and cold plus high altitude (in the Himalaya). Deaths in Nepal from pneumonia are reported as 4,429 (4.14% of total) for the year prior to the 2001 census and 7,170 from asthma/bronchitis (6.71% of total)[40].

2.4. RURAL ENVIRONMENT

2.4.1. Sanitation-Related Pollution

Table 2.2 indicates 59% of rural households don't have access to a toilet, having to use the surrounding countryside in the main. Settlement surroundings are thus filthy with human and animal excreta: infestation with flies and sanitary-related pollution results. Coupled with lack of knowledge on good hygiene practices and limited access to water, often carried by family members (women and children) from source and involving substantial time and labour, this contributes to a high incidence of diarrhoea related illnesses and mortality, especially in young children.

2.4.2. Indoor Air Pollution

Indoor air pollution resulting from the smoke emitted from solid fuels burnt in the home for cooking, heating and drying etc is a further major environmental health issue in rural areas. The health risks are likely to be especially high for women, who do the cooking, and young children who overwhelmingly tend to stay with their mother in the kitchen. Wood is the main fuel used though crop residues and dried animal dung are also used where available, especially in the Terai. It can be expected that burning kerosene in lamps for lighting will contribute also to indoor pollution levels but to a lesser extent. Appendix 6.7 reports a number of studies undertaken by NGOs, INGOs and the National Health Research Council. These studies demonstrate and illustrate the following:

- Much higher levels of the harmful pollutants PM_{10} and CO in indoor air when cooking involves the use of solid fuels in traditional stoves as opposed to when using kerosene, biogas or LPG fuelled stoves. The higher pollutant levels are associated with a doubled incidence of respiratory disease
- The positive impact on indoor air quality and health of fitting a smoke hood and ventilation chimney to traditional cooking stoves

[38] The population of a settlement rather than its density is the criterion used in Nepal to distinguish between rural and urban.

[39] NGIIP (2004), Map No. 7.6

[40] National Health Research Council (July 2004), "Situation Analysis of Indoor Air Pollution and Development of Guidelines for Indoor Air Quality Assessment and House building for Health".

- The higher fuel efficiency of improved cooking stoves (ICS) that enclose the fire in addition to venting smoke and gases to the outside. A potential halving of fuel consumption is achievable. However, some ICS units don't appear to reduce smoke levels appreciably, suggesting some problems with construction, operation and or maintenance.

Further improvements in stove and ventilation technology are probably possible and more extensive monitoring and epidemiological studies will help to better establish quantitative guidelines and disease burdens. However, taking evidence from many other worldwide studies with the above summaries and information presented at a National Workshop in August 2004[41], the observation that burning solid bio-fuels in traditional stoves in unventilated homes is significantly detrimental to health is compelling. However, whilst the number of households in rural areas amounts to several million, only about 100,000 ICS and a smaller numbers of biogas stoves have been installed to date. Hence much more application effort needs to be spent, to include:

- Technology dissemination and awareness of health benefits
- Developing mechanisms for easing the affordability of new technologies and
- Providing assistance with training and other forms of support regarding the maintenance and operation of installed technologies.

2.4.3. Rural Electrification

Similar comments as made above apply to rural electrification. In the absence of an electricity supply, rural communities suffer from *inter alia* (i) limited indoor lighting from kerosene/gas-fired lamps (ii) restricted access to learning and development of human capital (iii) lack or refrigeration facilities for keeping food fresh and antibiotic drugs viable (iv) reliance on human or animal energy for tasks which might otherwise be driven using electricity, etc. Though much work is being undertaken by various NGOs on developing solar and micro-hydro power and projects implementation, and while HMGN has set a 55% access target (PRS), concerted government policy and action to electrify rural Nepal seems lacking. Meanwhile the recent rise in oil prices has caused a marked increase in the subsidised price of kerosene, with likely adverse consequences for the affordability of lighting in rural households and the opportunities it offers or facilitates (e.g. scholastic study and adult literacy).

2.4.4. Agricultural Chemicals

Reported in 2000 as of increasing importance are the environmental, health (and ecological) risks resulting from the poorly managed use of pesticides in agriculture[42]. Pesticide use is increasing, especially in the production of commercial crops, but awareness of the hazards associated with their use seems lacking. For example, it was said several times during mission that produce is sprayed prior to coming to market so as to improve its "colour" and appearance. Similarly, fertilisers and herbicides have a significant role to play in increasing agricultural productivity and rural incomes but their careless or inappropriate use can put health, water quality and the environment at longer-term risk[43].

[41] Winrock International Nepal (September, 2004), "Report on National Workshop on Household Energy, Indoor Air Pollution and Health in Nepal, 27 August 2004".

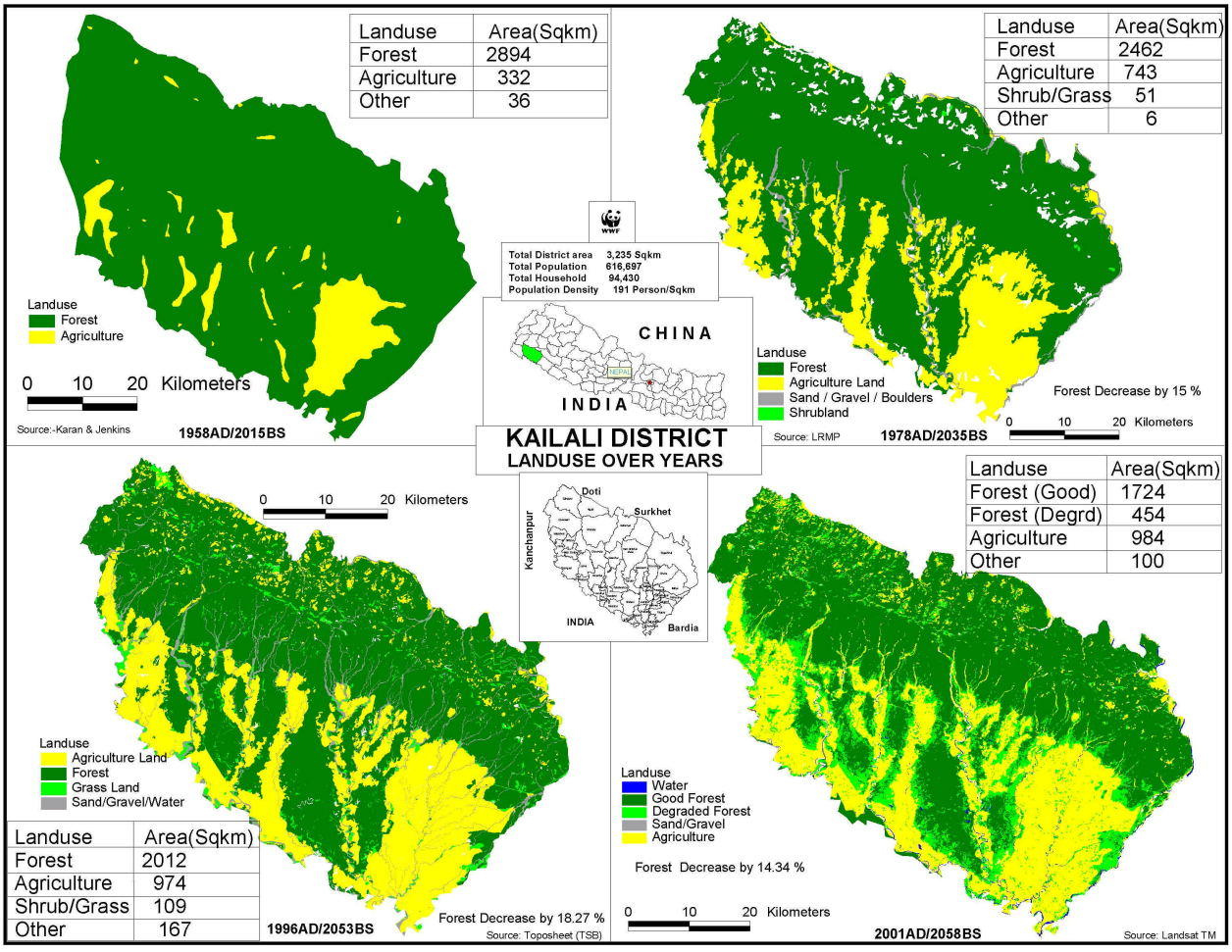
[42] Sharma, T. (November, 2000), "Strategy Paper – Environment Sector – With Special Emphasis on Industrial Pollution, Pollution Prevention, Air Pollution and Solid Waste". Revised Strategy for Danish-Nepalese Development Co-operation.

[43] Irrigation is another major agricultural technology that needs to be used sensibly for sustainable improvement in agricultural productivity. Increased soil salinity, waterborne diseases and sediment loads are aspects that may need careful consideration.

2.4.5. Forests and Deforestation

As noted in 2.2.1, the latest national assessment of forest cover made in 1994 indicated significant deforestation had occurred since 1978. The ADB has reported a 1.8% reduction in forest cover from 1990 to 2000, noting that much of the forested area between the Terai and the Himalaya has been cleared for agricultural purposes and human settlement and that soil erosion, landslides and floods have become more common as a consequence. Information provided by the WWF Nepal programme suggests that the Terai continues to face deforestation pressure, see Figure 2.6, though changes in land-use classification mean the trends are ambiguous. Anecdotal observations suggest that deforestation is significant locally, for example, trees being felled to provide fuel for brick making plants in urban areas, but a number of informants met on mission regarded deforestation as less of an issue nowadays. Of course, a growing rural population reliant still on wood as solid fuel for cooking and heating will inevitably place pressure on forests and their resources, but local (community) management of the forests (12 % of Nepal's forests are under Community management) may have offset this pressure leading to a more stable situation. In the absence of firmer quantitative information it is not possible to comment further.

Figure 2.6 Changing Land Cover in the Kailali District, Terai, 1958-2001 (c/o WWF Nepal)



2.5. URBAN ENVIRONMENTAL QUALITY

Resulting from demographic factors and other factors noted in 2.3, Nepal is becoming an increasingly urbanised population, with projections that the proportion of the population living in an urban setting will at least double from now in not many years time. Unfortunately, the provision of environmental infrastructure, land and development planning and institutional frameworks are weak or non-existent. Hence, population growth will result in significant environmental degradation of the urbanised areas unless urban policies and their implementation are strengthened.

2.5.1. Kathmandu Valley - Overview

Whilst the infrastructural and institutional weaknesses noted here are common to urban areas throughout Nepal, adverse impacts are currently most notable in Kathmandu Valley (KV) and to a lesser extent in Pokhara and a few other large towns. Most investigations have been made in the Kathmandu Valley and Appendix 6.8 describes the current situation as revealed by various project studies. Unfortunately, given the prevailing political and institutional climate, it is highly probable that conditions in Kathmandu Valley will worsen in the short-run hence the review should be regarded as a "wake-up call" signalling (i) the need for action and (ii) the qualitative future in store for other centres of urban growth if an unchanged path is pursued. Salient features are as follows:

1. Water supply for household use – supply fails miserably to meet demand; the delivered water is of unsatisfactory quality, having to be boiled before use. A major investment project to address these failings is years behind schedule owing at least in part to a corruption scandal concerning the development of access roads

2. Management of wastewater generated by households and businesses – apart from a small wastewater treatment plant (WWTP) upstream of a holy site on the Bagmati River, no wastewater is treated before discharge to the river system; tributaries to the Bagmati River are open sewers

3. Management of solid wastes generated by households and businesses – a landfill or waste dump was abandoned a number of years ago following local complaints: however, alternative arrangements were not in place and solid waste disposal since has involved burying the waste in trenches located alongside the Bagmati River, though much has also been dumped by communities adjacent to tributary rivers and streams. New facilities 25 km from the city have been developed but their capacity is very limited (sufficient to accept about 3 year's waste production); their further development will involve substantially greater investment and extending an access road some 9 km further into insurgent controlled territory. In short, waste disposal has been highly unsatisfactory from an environmental perspective and the sustainability of recent improvements is highly questionable

4. Management of clinical wastes from health-care establishments – there is no segregation of clinical (hazardous) waste from other wastes and no method of dealing with it even it were segregated; this waste presumably finds its way into the general waste stream and is dealt with accordingly, see above

5. River water quality – the absence of WWTPs and weakness in solid wastes management results in polluted rivers. River water quality standards don't exist yet and monitoring of river water quality isn't undertaken

6. Transport – the numbers of road vehicles (especially motorbikes and cars) and traffic congestion has increased significantly in recent years. A mass-transit trolley-bus system connecting Kath-

mandu and Bhaktapur closed in 2001 following financial losses believed to have resulted largely from governance failures: HMGN had announced its decision to privatise the unit earlier in 1999 but failed to follow-through with action. Public transport demand in KV is met largely by private diesel-fuelled minibuses and three-wheeler mini-cabs (LPG and electric powered), contributing to air pollution and road congestion, respectively

7. Air quality and environmental health – particulate air pollutants (PM_{10}), which are associated with acute respiratory infections (ARI), exceed the relevant national air quality standard for much of the time in the non-monsoon months. Principal causes are emissions from road vehicles and brick manufacture.

2.5.2. Causes of Urban Environmental Degradation

Kathmandu Valley has suffered environmental degradation in all aspects considered: the effectiveness of attempts at improvement appears rather limited or flawed. Concerted action addressing the causes of current environmental degradation would deliver improvement and, to the extent that the necessary actions are environmentally oriented, could act as a model for urban environmental planning and management in other large towns and cities in Nepal.

A number of root causes lying in failures of governance can be identified, as noted below:

- Constitutional and democratic instability – undermining confidence and causing great uncertainty for all institutions and stakeholders
- Immature, weak (or non-existent) democratic institutions - riven by factions seemingly driven as much (or more) by political intrigue and desire for status as by a desire to pursue office to implement economic and other policies and programmes that benefit the people and economy
- Weak government and municipality finances resulting at least in part from the prevailing low income levels - leading to a lack of investment in essential infrastructure (water, wastewater, solid waste) and weak operational finances
- Rural poverty coupled with limited economic opportunities in rural areas – this is a major driving force for migration into urban areas, which provide greater opportunities (despite urban environmental degradation), resulting in a substantial growth in demand for urban services
- Insurgency – adversely affecting economic growth; causing migration from the countryside into urban areas, exacerbating the enhanced demand for urban services (see above); it is also believed to result in the diversion of some government funding towards “maintaining” security. The insurgency also hampers the Government’s efforts to implement development projects (especially outside Kathmandu).
- Pervasive corruption – affecting investment projects, award of contracts, policy development and the funding of operational services and facilities
- Institutional weakness and inadequate capacity – resulting in inadequate appreciation by policy makers of the externality effects of policies and programmes; their piecemeal development in isolation rather than in coordination with others; ambitious policies with no matching implementation programme or strategy and an all-too-frequent failure to undertake concrete actions to implement policy and deliver achievement.

Most of these underlying factors are interactive. Equally clearly, they largely lie beyond the realm of environmental policy and action. However, linked with and subordinate to the root causes, more direct, proximate causes of environmental degradation in KV can also be identified:

- The absence of an environmental inspectorate with adequate institutional capacity to undertake a range of activities essential to an effective system for urban environmental management in Kathmandu Valley (and other urban areas), see 3.3.1
- A lack of capacity for (i) industrial emissions monitoring and (ii) air quality modelling, resulting in an inability to determine quantitatively and with confidence the influences on air quality of multiple sources of air pollutants, see 3.3.1
- The absence of standards for maximum pollutant emissions to air from stationary sources such as brick kilns and cement plants, see 3.3.3
- Transport and transport fuel policies that have not consistently promoted cleaner transport and improved air quality, see 3.3.4
- The lack of a system of strategic environmental assessment (SEA) of programmes and plans, combined with there being no system of land-use planning, has contributed significantly to haphazard urban development, see 3.3.1
- Inadequately resourced and insufficient capacity of the Municipal waste management department (KMC); the department having just four professional staff, though they are motivated and dedicated. Budget information was not provided but it is probable that KMC will be financially constrained from further development of its Sisdole landfill site[44]: development of the landfill and access road (at a site some 9 km beyond Sisdole) or some other disposal facilities is essential, however, for environmentally satisfactory waste disposal in the medium-long term, i.e. beyond 2008.
- The absence of a strategic plan to address wastewater management in Kathmandu Valley, coupled with municipal financial constraints, resulting in little or no investment in sewerage and wastewater treatment plants.

2.6. CROSS-SECTORAL ENVIRONMENTAL ISSUES – CLIMATE CHANGE

Nepal's contribution to man-induced climate change (global warming) is minor, its per capita emission of the global warming gas CO_2 being one of the lowest at 0.2 tonne/y since its electricity is mostly generated from renewable hydropower and the main fuels used in rural households are wood and crop residues whose combustion largely involves the short-medium term recycling of atmospheric carbon[45]. Transport fuels (diesel, petrol, LPG), kerosene (rural lighting, urban cooking) and LPG (urban cooking) are the principal fossil fuels burned in Nepal. Hence the issue essentially is how Nepal might be impacted by global warming, and what measures might be put in place to mitigate these effects, rather than Nepal's contribution to the problem. The major potential adverse impacts on Nepal of global warming may include:

- Glacier retreat and glacial lake outburst floods (see Appendix 6.10). Glacial retreat might also be associated with increased river flows and flood events in the short-run. But in the long-run, warmer temperatures and reduced glacier mass might reduce regional water resources
- Reduction in agricultural productivity resulting from losses of fertile soil through erosion, landslide and flood; reduced planting/cropping frequency; changed crop yields
- Increased vulnerability to disease.

[44] Waste transport vehicles for example are being provided to KMC through JICA funding (autumn 2005).

[45] This is true if forests are in balance, i.e. felling equals new growth. Net deforestation reduces the forest "sink" for CO_2.

2.7. POVERTY AND ENVIRONMENTAL INTERACTIONS

The EU's ultimate goal in assisting Nepal is to alleviate poverty, hence a prime purpose of this CEP is to help inform a Country Assistance Strategy on the likely environmental-poverty interactions. The principal interactions identified in this CEP are given in Table 2.8, though it should be noted that a number of the environmental issues are really developmental rather than environmental.

Table 2.8 Major Interactions between Environment/Ecology and Poverty

ENVIRONMENTAL/ ECOLOGICAL ISSUE	INFLUENCE ON POVERTY
Unsanitary conditions – rural households and vicinity	> Poor health (diarrhoea) and high infant mortality > Impaired human capital formation – education > Reduction in labour productivity
Inadequate access to wholesome water - rural	> As above plus ill-health if drinking water having an elevated arsenic concentration > Women and children fetching water – time which could otherwise have been spent on economic activity and education, respectively
Inadequate access to electricity - rural	> Impaired educational development > Eyesight adversely affected by low-level lighting > Low labour productivity
Indoor air pollution - rural	> Poor health (ARI) and increased mortality > Impaired human capital formation – education > Reduction in labour productivity
Misuse of pesticides	> Adverse effects on health - producers and users > Adverse ecological effects - reducing the availability of forest products, fish, birds, eggs etc to rural inhabitants
Misuse of fertiliser chemicals	> River and groundwater pollution, having potential adverse effects on drinking water quality and health
Deforestation	> Reduced availability of forest products > Increased travel times for collection of firewood etc > Reduced labour productivity
Loss of biodiversity and wildlife (rhino's etc) through poaching	> Reduced availability of natural, e.g. forest, products > Loss of cultural heritage > Reduced tourist numbers and income from tourism
Flooding	> Loss of life - disrupting household (family) structures, education and labour productivity > Injury and disease > Temporary/permanent loss of livelihoods
Landslides	> As above
Global warming	> As above – resulting from an increased incidence of flooding > Potential reduction in crop yields – temperature and drought effects > Potential adverse effects on biodiversity and income from tourism
River pollution	> Reduced numbers and availability of fish etc > Adverse effects on quality of water resources, and potentially health > Reduced tourist numbers and income from tourism
Earthquake	> Major disaster potential, especially in urban areas and particularly in Kathmandu Valley – major loss of life, serious injury and disease; destruction and disruption of livelihoods
Urban environmental degradation - general	> Elevated stress levels in urban dwellers, potentially contributing to (i) political unrest, street protests and agitation, adversely affecting economic activity and indirectly to (ii) an increased incidence of AIDS in the disaffected population > Reduced tourist numbers and income from tourism

ENVIRONMENTAL/ ECOLOGICAL ISSUE	INFLUENCE ON POVERTY
Ambient air pollution - urban	> Poor health (ARI) and increased mortality > Impaired human capital formation – education > Reduced labour productivity
Road traffic congestion - urban	> Elevated stress levels for urban inhabitants > Increased journey times > Reduced labour productivity
Inadequate quantity and quality of water supply – urban	> Disruption of work, sleep and leisure resulting from an intermittent water supply and the need to collect and store the water supplied > Unsatisfactory sanitation and hygiene, adversely affecting health > Reduced labour productivity
Inadequate wastewater management - urban	> Pollution of rivers and groundwater, potentially affecting drinking water quality and health > Reduced tourist numbers and income from tourism
Inadequate solid/clinical waste management - urban	> Visual and chemical pollution of rivers and groundwater, potentially affecting drinking water quality and health > Reduced tourist numbers and income from tourism

Effectively addressing these adverse environmental issues should impact favourably, therefore, on poverty in Nepal. In turn, economic growth and the alleviation of poverty should help to generate and mobilise domestic financial resources and investment needed to tackle the environmental problems. Poverty alleviation in areas adjoining reserves may also favourably impact poaching since most poachers are local and poor – poaching in response to foreign demand. Low economic growth, inequitable wealth distribution and a high population growth rate are probably the most significant root causes of poverty (and conflict) in Nepal, issues which lie beyond the scope of the CEP.

2.8. RESPONDING TO THE ENVIRONMENTAL/ECOLOGICAL ISSUES

All issues identified in Table 2.8 adversely affect the poor, whether directly or indirectly, and to varying extents. Table 2.9 outlines briefly some potential responses to address these issues and proposes quantitative indicators that could be used to help track progress, trends and overall effectiveness of the response effort. The responses are framed for EU support to central/local government and NGOs etc in Nepal. Precise modalities for providing support would need to be developed: it will take time and effort to identify appropriate partners, other stakeholders, determine the programme extent or project locations, allocate budgets, determine programme/project duration, and agree on the forms of support which could include general funding (support to domestic budgets, but earmarked for sectoral application, loan or grant finance, procurement or technical assistance. Priorities for EU support are suggested in Chapter 5.

Table 2.9 Specific Environmental/Ecological Issues, Potential Responses and Indicators

ISSUE	POTENTIAL RESPONSES	INDICATORS
Unsanitary conditions – rural households and vicinity	Provide rural sanitation facilities and teach good hygiene	> % access to sanitation > % incidence of diarrhoea > Infant mortality rate
Inadequate access to wholesome water - rural	Provide safe water supplies to rural communities	> % having access to water that meets Nepali quality standards > Time taken to fetch water from source to home
Inadequate access to electricity – rural	Programme to install and maintain rural electricity supplies – hydro, solar, power	> Per capita electricity generation and consumption
Indoor air pollution - rural	Programme to provide and install less polluting cooking and heating systems in rural households – e.g. ICS, ventilation, biogas, solar, briquette stoves	> % of households using unprocessed solid fuels for cooking/heating > % of households using solid fuel in traditional stoves without a fitted ventilation system > % incidence of ARI in women and young children
Misuse of pesticides	Extension programme to advise on best practice use of pesticides in agriculture	> Pesticide use per tonne of crop > Pesticide concentrations in produce sold at market
Misuse of fertiliser chemicals	Extension programme to advise on best practice use of fertilisers in agriculture	> Fertiliser use per ha of farmed land > Fertiliser use per tonne of crop
Deforestation	Promote ICS, biogas and solar cooking methods Support programmes to extend Community Forest Management Support programmes to help reduce rural fertility and population growth	> Total area of forest cover - broken down into meaningful categories by forest status > Area of community forests > Household firewood consumption (tonne/year)
Loss of biodiversity and wildlife (rhino's etc) through poaching and other factors	Support programmes to relieve poverty in areas adjacent to national parks and reserves, specially to ensure that the local communities receive financial benefit from species preservation (e.g. via tourist income)	> Census count for each threatened species (of mammals, birds, fish plants etc) e.g. rhinoceros count etc > Annual numbers of rhinoceroses, tigers etc killed by poachers
Flooding	Programme to identify the most at-risk areas: support the development and implementation of early warning systems and contingency plans in these areas. Ensure that the plans are rehearsed and that necessary materials are in place. Undertake risk reduction measures and develop early warning-contingency plans at glacial lakes where assessment reveals a high risk of GLOF.	> % of flood warning systems installed in most at-risk areas. > % of contingency plans in place and rehearsed in the most at-risk areas. > Number of GLOFs > Numbers of deaths and injuries caused by flooding
Landslides	Promote best practice in the construction of roads and other development to minimise the risk of landslides and mitigate their effects.	-

ISSUE	POTENTIAL RESPONSES	INDICATORS
Global warming	See flooding and landslides	> Glacier volumes, air temperature
River pollution	> Develop costed strategies and investment plans for controlling point and diffuse sources of river pollution. These should be developed on a river catchment basis, providing an integrated, holistic approach across defined physical areas. > Implement the investment plans; operate and maintain the facilities afterwards. > Monitor effluent discharges to river and the performance of operating facilities.	> River water quality monitoring vs. quality standards - % compliance > Volumes of treated and untreated effluents discharged to surface water > Pollutant loads (tonne/y) discharged to surface water > % of WWTP residual solids (dry basis) disposed of on land in a satisfactory manner
Earthquake	Based on an analysis of earthquake probability and the likely effects, prepare a strategy to minimise the consequences of an earthquake in high risk areas, e.g. Kathmandu; develop a timebound implementation plan and begin to implement it. The strategy should include *inter alia* minimum construction standards (buildings to withstand "design" events) and robust contingency plans.	> Existence of the strategy and plan and its endorsement by competent international authorities. > Proportion of buildings (new and converted) constructed to withstand a "design" earthquake. > Successful rehearsals of contingency plan/s.
Urban environmental degradation – in general	> Support the formation and capacity building of a national environmental inspectorate reporting to the Ministry of Environment, Science and Technology. > Support the preparation of legislation to introduce a land-use planning system, and support its application and development in Kathmandu Valley.	> Existence of the inspectorate and its annual expenditure > Number of monitoring events, samples taken and analyses made > Rates of compliance with ambient and discharge standards > Incidence of prosecution of persistently non-compliant point source dischargers > Results of environmental opinion surveys – residents and tourists
Ambient air pollution - urban	*Same as for degradation (general)* Develop an integrated air quality management strategy and plan based on air quality modelling coupled to an assessment of the benefits and cost–effectiveness of alternative control approaches. Key components should address (i) an integrated transport policy and plan considering transport routes, traffic restrictions, options for electrically powered transport, fuel and emission standards (ii) controlling industrial emissions through using a combination of good-practice production technology and pollution abatement.	> *See also degradation (general)* > Rates of compliance of ambient air quality (PM_{10}) with Nepali standard > Incidence of ARI in urban areas > Number of complaints from the public about air quality
Road traffic congestion – urban	*See ambient air pollution (i) above*	> Numbers of vehicles per km of urban road > Average road traffic speeds – in daytime and in "rush-hour" periods > Opinion surveys

ISSUE	POTENTIAL RESPONSES	INDICATORS
Inadequate water supply quantity and quality - urban	Support water resource and supply masterplan development as required.	> % having access to safe water > Per capita volume of water delivered to the water distribution system > % leakage rate from the water distribution system > % of time that tapped water is supplied to households > % of the water volume supplied to households that complies with Nepali quality standards
Inadequate wastewater management - urban	*See river pollution*	*See river pollution* > Investment and operating expenditure on sewerage and WWTPs
Inadequate solid/clinical waste management - urban	*Same as for degradation (general)* Develop an integrated solid and clinical wastes management strategies and plans – starting with Kathmandu Valley. Key components should address (i) wastes segregation and collection (ii) waste recycling and resource reuse opportunities (iii) residual wastes treatment and disposal (iv) environmental monitoring of waste management facilities (in consultation with the proposed environmental inspectorate).	*See also degradation (general)* > Quantities of waste generated, collected, recycled, treated and disposed of > Investment and operating expenditure on wastes collection, recycling, treatment and disposal.

In addition to the indicators noted above, other environmental management indicators may be proposed to help track environmental and ecological progress in Nepal:

- Number of policies, programmes and plans subject to a completed strategic environmental assessment (SEA)
- Existence of a system of land-use planning system
- Number of developments subject to IEE and the % not given approval
- Number of developments subject to EIA and the % not given approval

3. ENVIRONMENT POLICY, LEGISLATIVE AND INSTITUTIONAL FRAMEWORK

3.1. ENVIRONMENTAL POLICY AND LEGISLATION

3.1.1. Overview and Scope

Environmental policy is embodied in the Sustainable Development Agenda for Nepal 2003 (SDA), which subsumes the National Conservation Strategy (1988) and Nepal Environmental Policy and Action Plan 1993. The SDA aims to guide and influence national level panning and policies up to 2017 and declares itself in conformity with the Tenth Plan (2002-07), the Poverty Reduction Strategy Paper, the Millennium Development Goals and Nepal's international commitments. It states 21 broad goals that describe where HMG hopes to take Nepal by 2017. Whilst admirable – see Appendix 6.2 – the agenda is largely just that – an agenda. No priorities or milestones are set and little consideration is given to specific policies, programmes and mechanisms for bringing these goals to fruition.

The Environment Protection Act, 1997 and Environment Protection Rules, 1997 set out the framework for environmental impact assessment (EIA), pollution control certificates for operating industries, ambient air quality standards and concentration limits for wastewater discharges to public sewers and surface waters see Appendix 6.2. Subsequently, standards have been issued for vehicular emissions (2000); control measures banning polluting vehicles from Kathmandu and banning polluting brick kiln technologies (Bull Trench) have been issued; and a number of economic instruments have been applied[46]. The local Self-Governance Act, 1999 has been presented as a milestone as it permits local environmental problems to be addressed at the local level, but evidence was not found during mission to demonstrate its significance. Nepal has signed a range of international conventions and protocols (e.g. Basel, Stockholm, Rotterdam, Montreal, Kyoto) but there are weaknesses in their implementation due in part to institutional capacity deficiencies (MoEST comment).

Given the embryonic nature of environmental management in Nepal there are inevitably a number of legislative gaps. The most significant gaps are considered to be: strategic environmental assessment (SEA) of plans and programmes; a system of land-use planning to ensure development is consistent with environmental considerations, transport and other local factors; quantitative limits on industrial emissions to air; river catchment management and ambient surface water quality standards (WQS) to satisfy water quality objectives (WQO), though ambient WQS are currently being proposed by MoEST (standards not seen during mission); detailed regulatory guidance on minimum acceptable industrial production technologies; and detailed regulations governing solid and hazardous wastes management and environmental safeguards.

3.1.2. Environmental Impact Assessment

The Environment Protection Rules, 1997 identify the potential developments that, dependent on the capacity of the proposed development, require either an initial environmental examination (IEE) or environmental impact assessment (EIA). Proposals falling under the bar set for an IEE require no environmental examination or assessment. Public consultation is provided for under the Act and im-

[46] Fuel tax on petrol and diesel in Kathmandu Valley (not operational yet); reduced import tariff on spare parts for electric vehicles; tax benefits for industries installing pollution control equipment; higher tax rates for the registration of older (more polluting) vehicles; tax concessions for "environment friendly" investments.

plementing Rules, but how effective this is at present is hard to judge. The assessing authority varies according to whether an IEE or EIA is submitted:

- IEEs – assessed by staff of the relevant sectoral ministry, e.g. agriculture, forests, transport
- EIAs – assessed by staff of the Ministry of Environment, Science and Technology (MoEST)

Identified shortcomings of the environmental assessment system include: (i) no provision is made for the cumulative impact resulting from multiple developments, especially those too small to warrant an IEE e.g. an IEE is required for an hotel development of 50-100 beds but not for several hotels each of less than 50 beds in the same area (ii) though provision is made for alternative development locations to be identified and assessed, its practical implementation is weak – developers in effect become committed to the one site (iii) though Ministry staff stipulate necessary measures to comply with discharge standards and areas where mitigation is required, inspection of the development in progress is not routinely conducted due to pressure of time and resources and lack of institutional capacity (iv) officials in sector ministries assessing IEEs do not necessarily have adequate capacity in environmental assessment and are likely to have conflicts of interest. The first of these issues highlights the need for SEA, which forms a valuable function in sectoral mainstreaming of environmental considerations into sectors such as transport and industry, see 3.3.

a) Surface Water Quality Standards

As already noted, surface water quality standards (WQS) are being developed by MoEST but have yet to be published or approved. Section 3.3.1 deals with this cross-sectoral issue in relation to river catchment planning.

b) Air Quality Management

Nepali policy and legislation in this area concerns ambient air quality management (focusing on urban aspects) rather than indoor air pollution (though this affects more people). Urban air quality is an important issue, politically as well as from an environmental health perspective, so the legislative focus is understandable. The national ambient air quality standards (see 6.2) form a sound basis for air quality management and the AQM undertaken in Kathmandu valley and other urban areas of Nepal highlights the problem of high levels of respirable particulate material PM_{10} and $PM_{2.5}$ outside the monsoon months. Transport and industry have been identified as the sectors primarily responsible for the elevated pollutant levels and legislation tackling these sectors' contribution to urban air pollution has been enacted, primarily addressing Kathmandu Valley:

- Standards for operational vehicle emissions and emission control system introduced 1995
- Ban on diesel powered three-wheeler vehicles in Kathmandu Valley imposed in 1999
- Nepal vehicle mass emission standard (EURO-1) has been applied since 2000 to the import of all vehicles to Nepal. A gradual shift to EURO II and EURO III standards is expected
- A ban on the import of two-stroke engine, used and reconditioned vehicles since 2000
- Two-stroke three-wheel vehicles and taxies older than 20-years banned from Kathmandu Valley since 2004
- A ban in Kathmandu Valley on public transport vehicles older than 20-years - under consideration
- A ban on new registrations of Bull's Trench brick kilns in Kathmandu Valley, and all those currently in operation to be converted to cleaner technology options by the close of 2004.

The effectiveness of these legislative measures is hard to judge yet given the relatively short length of the AQ time series data and its inherent variability. It is also unclear as to the degree and effec-

tives of legislative enforcement. What is clear though is that many or most of the vehicles banned from Kathmandu Valley are unlikely to be taken out of operation, but merely relocated to other urban areas in Nepal where they contribute to local (but probably less severe) air pollution. What is missing from the legislative agenda currently, however, are measures concerned with (i) managing the root causes of urban traffic volume growth and (ii) preventing and controlling air pollutant emissions from industry, see 3.3.1/4/5.

3.2. ENVIRONMENTAL INSTITUTIONAL FRAMEWORK

3.2.1. Institutional Structures and Coordination

At a national level the Environment Protection Council, to which the Ministry of Environment, Science and Technology (MoEST) is the secretariat, decides the direction of policy. MoEST prepares policy and also implements it. Sectoral Ministries play a role through the system of IEEs: i.e. the Ministries of Industry, Commerce and Supplies; Labour and Transport Management; Forests and Soil Conservation; Physical Planning and Works; Health; Water Resources; Local Development etc.

There is no separate, funded national environmental agency or formal coalition of agencies charged with the responsibility of (i) undertaking investigative studies to inform policy formation and (ii) implementing environmental policy and legislation – to include monitoring and enforcing compliance with detailed implementing regulations. This is a fundamental weakness of existing institutional arrangements, compounded by other factors:

- Ministry staff can be and are moved out of an environmental post to another quite different post and vice versa. Whilst it might be argued that (in principle) this forms good administrators, it diminishes environmental planning and management capacity and undermines the will and motivation of officials to acquire this human capital
- Governmental staff having some acquired capacity in environmental management perhaps number about a hundred[47]. These could form a core team able to make concerted progress, but they are divided amongst different ministries and, as noted above, their capacity once gained can wither
- Officials in sectoral Ministries may at times experience conflicts of interest between environmental safeguards on the one hand and the development objectives and goals of the promoting Ministry on the other hand. Coupled with perhaps limited environmental capacity and with a lack of strategic environmental assessment, the effectiveness of the IEE system may be questioned
- Policies developed by various Ministries tend to be drawn up in isolation - and may conflict therefore - rather than being developed in a coordinated, integrated fashion[48]. This is a recipe for stagnation, procrastination and prolonged politicking which militates strongly against effective and vigorous development action. There are many instances of this.

Beneath national government in the regions and districts, sectoral ministries have district level offices: Office of Small and Cottage Industries, Water Supply and Sanitation Office, District Agricultural Office; District Forest office; District Development Committees; and Metropolitan / Municipal offices.

[47] Personal communication from MoEST officials

[48] Almost all those consulted in the mission made this rather damning point.

3.2.2. Other Institutional Stakeholders

Many domestic and international NGOs engaged in the environmental-ecological sphere are active in Nepal. Indeed they play a vital, stimulating and coordinating role in helping to innovate, develop, implement and promote practicable cleaner technologies, in the rural areas in particular; to protect and conserve wildlife, plants and ecosystems; and raise awareness on environmental-ecological issues. Many work in partnership with HMGN Ministries, producing numerous insightful publications. Several such NGOs were visited on mission (7.3). Their main areas of interest include:

- Centre for Rural Technology – renewable energy (water mills, solar, hydro), indoor air pollution and preventive technologies, rural water supply
- ICIMOD – sustainable livelihoods in mountain areas, nature and wildlife conservation
- IUCN Nepal – nature conservation, urban air quality, transport policy, awareness raising
- Practical Action (formerly ITDG) - indoor pollution and preventive technologies, rural transport, rural electrification, rural sanitation, rural adaptation to climate change, flood contingency planning
- Winrock International – transport, urban air pollution
- WWF Nepal Programme – nature and wildlife conservation, climate change

The staff working at such NGOs are clearly very motivated and making real achievements. But assessed against the scale of the poverty and environmental-ecological challenges facing Nepal, their efforts are not enough. Given the resources and will, HMGN could perhaps support such NGO's efforts to a much greater extent in future, involving them as agents in delivering improvement against national strategies and plans addressing key environmental-ecological issues (see 2.9).

Numerous other institutes, academies and associations are also stakeholders in the environmental area, as of course are the many multinational and national donor agencies (see 4). Indeed, without the presence and activity of the donor and NGO community it is questionable what progress and development in this area would have been possible in Nepal.

3.2.3. Institutional Capacity and Resources of Environmental Management Authorities

The institutional capacity and resources of MoEST and other HMGN Ministries is briefly reviewed in 3.2.1. Approximately 100 staff within HMGN have some degree of environmental management expertise or awareness, sufficient to provide a core that could be capitalised on, but the staff are spread between departments and Ministries. Most damaging for environmental management is that there isn't in practice an institution capable and responsible for regular environmental monitoring and enforcement of legislation. Information on environmental budgets and expenditure was not provided in mission; the time available was insufficient for a more meaningful institutional analysis to be made. The principal issue though is the absence of an environmental inspectorate or agency. This must be established with adequate funds: it would require a dedicated assignment to assist MoEST define the remit of this inspectorate, its relationship with MoEST and other ministries (policies would be designed and approved at Ministerial level), its budget and capacity building requirements.

The Kathmandu Metropolitan City (Environmental Department) is responsible for solid waste management in Kathmandu. As noted in 2.5.2, this department has just four professional staff, which is quite insufficient for the effective development and implementation of an integrated wastes management strategy that safeguards the environment and health, but there was insufficient time on mission to undertake a meaningful institutional analysis and assessment of capacity building needs.

3.2.4. Protected Areas

National Parks and other protected areas (see 6.2) comprise about 18% of Nepal's land area. Buffer zones have been created also in order to help protect the enclaves. HMGN has made provision for returning up to 50% of the revenue generated by national parks and wildlife reserves for community development activities in the relevant buffer zones so as to win local support and stewardship . This practice has not only improved relations between local people and park authorities but also facilitated the community based institutions and improved socio-economic conditions .

A major conservation initiative is the trans-national Terai Arc Landscape (TAL) strategic plan (2004-14), covering an area of 49,500 sq. km (47% in Nepal), proposed by WWF Nepal and endorsed by HMGN. The TAL is one of the most biologically diverse habitats on earth, comprising a network of protected areas (4 in Nepal including the Royal Chitwan NP, 7 in India), forests (over 75% of the remaining forests in the Terai and Churia foothills - annual Terai forest loss 1978 - 1991 was 1.3%), agricultural land, rural and urban settlements and water bodies. The plan has been formulated to address the fragmentation of the natural wildlife habitat of the Terai; which forces wildlife to remain in insular refuges, too small to support many species and their ecological interactions. Seven broad programme areas have been identified: (i) policy and advocacy (ii) institutions and coordination (iii) sustainable forest management (iv) sustainable development (v) species and ecosystem conservation (vi) Churia watershed conservation (vii) awareness and education. WWF Nepal Programme's 2003-04 expenditure on the TAL Programme was 54.9 million NRs.

3.3. INTEGRATION OF ENVIRONMENTAL CONCERNS INTO THE MAIN SECTORS

3.3.1. Cross-Sectoral Considerations

The review of environmental policy and legislative framework has highlighted a number of generic weaknesses in the current arrangements which affect all main sectors having environmental concerns and issues. Cross-sectoral actions that would help overcome these generic deficiencies are:

- The formation of a properly funded, national environmental agency (inspectorate) with the capability of developing an institutional history and consolidating Nepali environmental expertise – this agency would *inter alia* be able to advocate such a strategic, coordinated approach and raise awareness at high levels of government
- The adoption of strategic environmental assessment into legislation and its application to policies, programmes and plans during their preparation
- The adoption of a system of land-use planning and authorisation/approval
- The adoption of river catchment planning as a formal basis for regulating surface water uses (drinking water, irrigation, industry, hydropower etc) and surface water quality management.

a) National Environmental Agency (Inspectorate)

Formation of a national environmental agency, adequately financed and equipped, with the human capacity to undertake a range of essential activities for effective urban environmental management is essential. It should be national, with regional outstations, so as to deliver economies of scale. Essential activities include (i) environmental monitoring (air[49], water, wastes); (ii) monitoring of point-

[49] At present, for example, the (AQM) programme in KV is dependent on continued resourcing from Danida.

source emissions to air and discharges to water; (iii) environmental modelling to assess the impacts of varying levels of pollutant discharge on the environment – water and air, whether from stationary or mobile sources; (iv) enforcement of environmental emission and discharge standards; (v) inspection of manufacturing facilities, promotion of pollution prevention (cleaner production) and resource efficiency measures to industry, and advising government on the availability of less polluting production technologies and pollution control technologies (vi) environmental assessment at both the project and strategic level (SEA); (vii) provision of expert advice and support on river catchment planning and management; and (viii) assess the economic benefits and costs of alternative pollution prevention and control approaches and measures, and advising HMGN through MoEST accordingly.

Such an inspectorate would likely report to Government through MoEST, but might report on technical matters – local monitoring and enforcement - to municipal authorities . In addition to its monitoring and enforcement role it would provide quantitative, informed advice on environmental matters to policy makers in Government. It should, for example, have sufficient expertise in emissions assessment and environmental modelling to be capable of determining with some confidence the relative influence of vehicular traffic, brick kilns and other potential sources on PM_{10} air pollution in Kathmandu Valley, and advise on robust policy options. At present, such influences can only be inferred from time series AQM data (see Appendices 6.7 and 6.8). An inspectorate needs to be established and its capacity developed if current and future urban environmental issues are to be addressed in a comprehensive, timely and effective manner.

b) Strategic Environmental Assessment and Land-Use Planning

The lack of a requirement for strategic environmental assessment (SEA) of programmes and plans and the absence of a system of land-use planning can contribute to environmental degradation and haphazard urban development. In the absence of SEA, the cumulative and indirect environmental effects of a sectoral development programme are unlikely to be formally identified, let alone examined. Whilst the task of undertaking SEAs should fall to sectoral ministries it should be expected that they would receive support from the proposed environment agency or MoEST, or be required to submit draft SEAs to the agency or MoEST for consultation and expert comment.

The absence of land-use planning means that Ministry personnel have no land planning framework criteria against which to assess development proposals subject to initial environmental examination (IEE) or environmental impact assessment (EIA): and no land-use basis therefore for denying development approval or requiring modified technical proposals or use of an alternative site. In urban areas the resultant, random sprawl contributes to traffic congestion and is not conducive to the development of mass-transit systems that may offer much less-polluting transport options.

c) River Catchment Planning

Given the lack of environmental management infrastructure, rivers downstream of urban areas are polluted by domestic and industrial wastewaters and solid wastes to varying extents depending on the pollutant loads and river flow rates. Diffuse inputs of nutrients and residues from agriculture and soil run-off may also exert a significant adverse impact on water quality, aquatic eco-systems and downstream water users, most notably in the dry, pre-monsoon period.

Surface water quality standards (WQS) are under preparation by MoEST but not yet published or approved; no surface water quality data were seen during mission. Objectively, WQS should reflect the minimum quality requirements needed to satisfy defined water quality objectives (WQO), e.g. a source of drinking water (pre-treatment), being supportive of salmon and trout fish, or used for wastewater disposal etc. Different sections of a river catchment may then be classified according to

their objective use or purpose – this is ideally done as part of the process of preparing a river catchment management plan. Through modelling the impact of conjectured effluents on river water quality, this approach provides an objective basis for deciding the limiting pollutant loads that can be accepted by a river. Discharges can then be controlled objectively over time so as to meet and maintain minimum acceptable quality. That is the ideal but it is unclear at present how the proposed WQS will be used and the basis of their formation.

d) Agriculture, Rural Roads and Forests

Improved agricultural productivity and access to markets is a key feature of the Government's poverty reduction strategy, as embodied in the Agriculture Perspective Plan. This implies boosting crop yields through use of agricultural technologies – irrigation; higher yielding, disease resistant crop strains and animal breeding; fertiliser use; and the application of pesticide and herbicides – and the development of commercial cash crops. However, for farmers to gain financial benefits (over and above the nutritional benefits) from productivity improvements, access roads must be in place. Otherwise produce cannot be delivered to market in timely fashion. Hence road construction is a priority of the Government's development programme; also, many NGOs are active in developing and promoting effective methods for transporting goods up and down the hill slopes to access roads.

In pursuing the above development effort, care does however need to be taken that environmental safeguards are respected and adhered to, in particular regarding the safe, sustainable use of agricultural technologies (fertilisers and chemicals in particular) and road construction. With regard to the former, criticism was heard during the mission of one multilateral lending agency whose focus was alleged to be on development of commercial crops, paying little attention to environmental matters. Road construction leads unavoidably to some destruction of (forest) habitat and, if constructed or located inappropriately, may precipitate landslides and soil loss, see e.g. Figure 3.1. For it to serve its purpose a road must also pass through prime agricultural area but this doesn't always happen, apparently due to corruption, incompetence, lack of coordination or a combination of factors.

The first of these issues needs to be addressed primarily through enhanced sectoral policy design and in practice through strengthened extension services providing awareness raising on the risks that using chemicals pose, and knowledge and training in their appropriate use. The second of these issues needs to be addressed through the planning process – through subjecting sectoral programmes to SEA prior to and as a condition of approval and, for specific projects, through the initial environmental examination (IEE) and environmental impact assessment (EIA) stages[50].

Figure 3.1 Landslide on Prithivi Highway (ICIMOD Annual Report 2003)

[50] DFID in Nepal has supported an interesting study of the benefits and disadvantages of manual road construction as opposed to the common method of using a bulldozer. On balance the manual method tends to result in a more sustainable road, provides local income during road construction and is of equivalent total cost.

e) Hydroelectric Power Generation

At 63 kWh, Nepal's per capita annual electricity consumption (2001) is one of the lowest in the world and Nepal's progress in this area compares unfavourably with that of other Asian countries. For example, per capita power consumptions of Bhutan and Nepal in 1980 were identical, 17 kWh: while Nepal's per capita consumption has grown to 63 kWh over the following 21 years, Bhutan's has grown four times as much to 241 kWh (UNDP Human Development Report). Given Nepal's significant hydroelectric power potential (43,000 MW) and that only about 1.5% of this has been developed, much greater progress could be made without adding to air pollution from fossil fuel combustion. The economic, health and environmental benefits to Nepal of exploiting its hydroelectric power potential are substantial. Offsetting environmental concerns, which need to be addressed in each project IEE or EIA, revolve around the need to prevent, minimise or mitigate the following potential adverse effects:

- Loss of forest or other land taken for infrastructure construction - whether a dammed or run-of-river project
- Displacement of rural people
- The risk of upstream landslide or GLOF
- Potential adverse impacts of an access road/s to the development site/s (e.g. landslides).

However, for a development activity which is relatively common and mainstream in Nepal, one which on balance is likely to confer substantial benefits, the time reportedly taken to complete EIA procedures – about 18 months – is unduly long. The procedures need to be examined with a view to streamlining them (speeding up the process) whilst ensuring that proper environmental safeguards are maintained. It is understood that NORAD is currently supporting capacity building in the EIA of hydropower projects with this objective in mind.

3.3.2. Industry

Industrial enterprises can adversely affect the environment through their emissions to air, discharges to water (directly or via a public sewer) and the storage and disposal of solid and hazardous wastes. It is desirable to apply an integrated approach to preventing and controlling pollution from enterprises whose activities are potentially capable of causing significant pollution. Enterprises in subsectors such as brick manufacture and carpet manufacture and dyeing lie in these categories; affecting air quality and water quality respectively.

a) Industry Emissions to Air

The impact of one or more brick kilns (for example) on air quality and environmental health depends on a number of factors: (i) the technology used to make the bricks, and how that technology is used by the operators (ii) the type of air pollution control (abatement) equipment installed to treat the emissions before release to air, and whether and how this equipment is used by the operators (iii) the mass flow and concentration of pollutants in the released gases and their temperature (iv) the height/s above ground at which pollutants are released to air (v) meteorological conditions - atmospheric stability, wind speed and direction – and nearby topography and (vi) the location of the emissions release point/s relative to the workers or inhabitants in the vicinity. All these factors should be addressed thoroughly in an EIA, for which legislative provision is made, but the situation is less satisfactory for existing operational plants in Nepal (Kathmandu Valley). Whilst there is legislative provision to close factories that are judged to be unacceptably polluting, the legislative mechanisms for arriving at this judgement are rather weak. Specifically:

- There appears to be no published regulatory guidance on what is considered environmentally acceptable manufacturing technology, resource use efficiency, and pollution abatement methods appropriate to potentially polluting manufacturing sectors. In the EU, for example, this guidance and regulation is exercised through the mechanism of integrated pollution prevention and control (IPPC), with especial regard to best available techniques (BAT) as detailed in the sectoral BAT reference documents (BREFs) prepared by the European IPPC Bureau.
- The application of BAT, or its equivalent, can be expressed as an indicative maximum mass and concentration limits for pollutant emissions released to air, i.e. compliance with such limits implies that BAT is being applied. Currently, however, Nepali legislation imposes no mandatory limits on emissions to air from industry. This is a serious deficiency, which denies environmental regulators a key institutional mechanism for monitoring and enforcing industrial air pollution control. Instead, public complaints and anger are rather more likely to trigger action by environmental authorities.
- The absence of standards for maximum pollutant emissions to air from stationary sources such as brick kilns signals a perception in industry that government lacks interest and concern about industrial emissions to air.

Regulations addressing the above points should be introduced and enforced, though the monitoring and enforcement of emission standards will likely require substantial institutional capacity building to achieve the desired result. Rigorous enforcement of such regulations - coupled with the application of EIA - will result in any new plants having to adopt cleaner technologies, appropriate emissions control equipment and be located on sites where the impacts on air quality affecting nearby people will be acceptable. The regulations will also need to state a firm deadline – perhaps 3 or 5 years - for existing plants to comply, failing which they must be closed. Through this mechanism it can be expected that the brick making industry, for example, will restructure. This is likely to lead to a smaller number of more efficient firms able to afford the cleaner technologies, benefiting from economies of scale through operation at higher throughputs and capacity levels. The environmental and health impacts of brick kiln emissions will be significantly reduced as a result.

b) Industrial Effluents Discharged to Surface Water

Table 6.2.2 abstracts some of the maximum tolerance limits (concentrations) for effluent discharges listed in the Environmental Protection Rules, 1997. The limits concern industrial effluent discharges to surface water or to public sewer and effluent discharged to surface water from combined wastewater treatment plants (WWTP) – plants treating mixed domestic and industrial wastewater. Information on the monitoring, compliance and enforcement of these limits was not available during mission. On the whole the limits are quite appropriate but a few critical comments can be made:

- The limits refer to concentration alone, with no indication of limiting pollutant loads. Hence this may allow an enterprise to meet the limit by using excess water i.e. by dilution.
- It is generally appropriate for the limits on industrial effluent discharged to public sewer to be considerably laxer than those applied to discharges directly to surface water. However, in the current situation, where there are few if any municipal WWTPs, public sewers themselves discharge directly to surface water. Hence enterprises have little or no incentive to provide pre-treatment or full treatment of their effluents – discharge of untreated effluent to sewer will be the obvious choice for most factories.
- Odour and colour limits are missing, omissions which are significant if concerned with the effects of effluents from the wool processing sector (carpet manufacture and dyeing), and their control. The standards recommend that, “as far as practicable, colour and unpleasant odour should be

absent", but this recommendation lacks force and is a weak starting point for controlling potentially highly polluting effluents.

- Limiting ammoniacal nitrogen limits are set at 50 mg/l, compatible with WWTPs that do not nitrify i.e. do not oxidise ammoniacal nitrogen (NH_4-N) to nitrite and nitrate. However, non-nitrifying WWTPs discharge maximum loads of free ammonia (NH_3 in solution), which is toxic to fish. Dependent on the effluent volume relative to river flow - especially relevant in the dry winter months – more stringent standards might be required at some discharge sites in order to meet future surface water WQS values.

3.3.3. Urban Transport

National transport policy (2001) stresses the need for clean energy and the use of electric vehicles: its implementation would likely make a major contribution to improving ambient air quality in Kathmandu Valley and other urban centres in Nepal. In addition to ambient air quality standards being in place, there now exists a number of vehicle emission standards applied to new and operating vehicles (see 3.1.4) and market based instruments. However, coherent action programmes to deal with urban transport are not in place and policies can conflict:

- On the positive side, government has banned polluting two-stroke, three-wheeler vehicles from Kathmandu (effective 2000) and applied emission standards to vehicles dependent on age and fuel type[51].
- However, government has subsidised diesel fuel, which undermines the competitiveness of electric-powered versus diesel-fuelled mini-buses for public transport; electric three-wheelers (Safa Tempos) face difficulties in getting route permits; and the enforcement of emission standards is undertaken by the traffic police, paper print-out results of the emission tests are not issued - the procedure is believed to be seriously compromised by corruption.
- Recent closure of the unreformed Kathmandu-Bhaktapur electric trolley system, (see 6.7.7).

Urban traffic volumes have grown for a number of reasons including population growth and economic growth. A major contributing factor to traffic growth and road congestion though is the absence of land-use planning. Such a system would allow better management and coordination of urban development making it more likely that mass public transport services could be established. Such services would ideally be electrically driven or at least use clean fuels more efficiently. To some extent these services would obviate the need for private vehicles and reduce congestion, hence further reducing air pollutant emissions.

3.3.4. Wastewater Management

Municipalities are required under the Tenth Five-Year Plan to install facilities to treat wastewater before discharge to surface waters (MoEST). This might stimulate municipalities to invest in sewerage networks and wastewater treatment plants, but the investment required would be considerable and it is unlikely this could be afforded using domestic funds alone. In the absence of river catchment management and planning and objective surface water standards, however, it is difficult to see how objective bases for the design of such systems: the investments may not be optimal. This consideration reinforces the recommendation that a system of river catchment planning and management needs to be implemented in Nepal. Substantial institutional development and capacity building is likely to be needed in future.

3.3.5. Wastes Management

Kathmandu Municipal Environmental department has just four professional staff. Its institutional capacity is far removed from that needed to keep up to date with waste management technologies and techniques; develop and sustain a long-term waste management strategy; implement the strategy; manage facilities and operations; address hazardous (e.g. clinical) waste management; and undertake necessary *ad hoc* investigations etc. Current legislation doesn't cover the environmental aspects of solid and hazardous waste management. At the very least, regulations should be developed and approved to provide guidance to municipalities on appropriate waste management technologies including collection, recycling, treatment and disposal; and environmental safeguards. Substantial institutional development and capacity building is likely to be needed in future.

3.3.6. Tourism

Tourism can play a significant role in Nepal's economy but sustainable tourism requires that the environment is pleasing to visitors and that tourism itself doesn't degrade the environment and ecology. Achieving both a pleasant environment and ensuring that visitors don't spoil what they have come to see or experience is challenging, but success is a must if tourism is to develop sustainably. While Nepal's Sustainable Development Agenda is not silent on tourism, it rather takes its development for granted. Claiming, for example, that "Tourism is an easy source of income for Nepal, requiring relatively less investment, and providing many jobs: at times it can even take advantage of the lack of infrastructure in remote areas." Given the recent dramatic decline in tourist numbers and revenues (largely as a consequence of the insurgency) and the results of surveys of tourist perceptions regarding pollution in Kathmandu, this is an exceedingly complacent statement.

The picture of urban environmental degradation painted earlier is for the most part visible to such tourists and is hardly conducive to their positive endorsement of Nepal as a tourist destination, especially when other "exotic" destinations are available without the environmental downside. Effectively addressing (i) the environmental degradation of urban Kathmandu, in particular and (ii) poverty in the areas surrounding the national parks may be regarded as essential for the sustainable development of the tourism sector in Nepal. A positive approach for informing future policy development, for example, would be to undertake an economic assessment of tourism, taking into account the positive and negative impacts of a good quality and degraded urban environment, respectively, in Kathmandu Valley. Also to undertake a SEA on a national or regional tourist policy or plan.

[51] Full details are provided on HMGN's MoE website.

4. EU AND OTHER DONOR COOPERATION WITH THE COUNTRY FROM AN ENVIRONMENTAL PERSPECTIVE

While international cooperation with Nepal has prioritised poverty alleviation, economic growth especially in the agricultural sector, and improved delivery and quality in the health and education sectors, significant direct initiatives in the environmental and ecological sectors have been and are being made. Though certainly not exhaustive, Table 4.1 lists major cooperative initiatives in this area plus noted activity in disaster prevention and mitigation.

Table 4.1 Instances of Cooperation in Environmental and Ecological Sectors

COOPERATION INITIATIVE	COOPERATING AGENCY AND NOTES
Environment Sector Programme Support (ESPS)	DANIDA (2001-2005): now closed - included initiatives in (i) cleaner production (prevention of industrial waste and pollution at source) and (ii) centralised industrial wastewater treatment in industrial zones of the Terai (Hetauda Industrial District).
Energy Sector Programme Support	DANIDA - continues until December 2005: included indoor air pollution monitoring and health assessment
Air Quality Management	DANIDA - air quality monitoring in Kathmandu Valley and other cities in Nepal, coupled with environmental health assessment. AQM in KV will continue subject to continued funding by HMGN and DANIDA.
Integrated Environment Programme (IEP)	DANIDA – project designed but suspended following the King's assumption of executive powers on 1st February 2005: the project appraisal mission was terminated and members returned early to Denmark. It is understood the programme would include capacity building of an MoPE/MoEST proposed Environment Protection and Conservation Agency / Department – which would act as an agency to implement environmental legalisation and monitor compliance etc. Acceptance of the proposal by HMGN (it is understood the proposal is under review by Ministry of Finance) is understood to be a precondition of continued DANIDA support in the environmental sector.
EIA of Hydropower Projects	NORAD/DN together with implementing agency MoPE (MoEST)
Environmental Management	FINNIDA – completed 2002. Activities: - environmental management and eco-labelling - strengthening environmental administration and management at municipality level (MLD) - environment support fund for NGOs and CBOs (NEFEJ)
Indoor Air Pollution	DFID and ITDG – investigations into indoor air pollution and the effectiveness of preventive technologies such as smoke hoods. SNV - alternative cleaner energy, biogas program
Kathmandu Metropolitan Solid Waste Strategy	JICA – support to developing a solid waste management strategy for Kathmandu Metropolitan City, design modifications to the new Sisdole landfill site and provision of waste transfer vehicles
Second Agricultural Program in Nepal (Loan 1604)	Asian Development Bank
Fourth Rural Water Supply and Sanitation Project in Nepal (Loan 1464)	Asian Development Bank
Urban Sector Strategy Study (TA 3272-Nep)	Asian Development Bank (1999-2000)
Urban and Environmental Improvement Project	Asian Development Bank (2002) – urban areas outside Kathmandu Valley

COOPERATION INITIATIVE	COOPERATING AGENCY AND NOTES
Biodiversity Conservation	UNDP and WWF Nepal Programme – conservation work in many national parks and conservation areas
Terai Arc Landscape	WWF Nepal Programme – sustainable conservation of landscape and ecosystems for wildlife compatible with sustainable livelihoods for communities in this area.
Disaster Management Programme	UNDP – assistance with preparation of master plans for disaster management including hazard analysis but focusing on coping with the effects of natural (disaster) events. Focused on up to 6 vulnerable districts, numbering 2 to 6; developed a disaster management information system database. A goal is to assist the mainstreaming of disaster management into the planning function. WHO – analysed the vulnerability of a Kathmandu hospital to earthquake damage.
POPs Regulation and Management in Nepal	UNIDO/GEF with implementing agency MoPE (MoEST) – 2003 to 2005

In addition to multilateral and bilateral cooperation, there exist a multitude of NGOs and INGOs (see 3.2.2 for a partial list) active in various fields including: natural resource management; biodiversity and ecological conservation; renewable energy technologies in rural areas (water-power, bio-gas, solar); fuel, stove and ventilation technologies to alleviate indoor pollution; flood forecasting, contingency planning and mitigation.

While many of the environmental programmes and projects have provided valuable information and helped raise awareness it is less clear that all have achieved major lasting effect. Deficiencies in long-term impact may be ascribed principally to inadequate institutionalisation and governmental weaknesses in implementing policies and plans. Addressing the institutional issues is fundamental to achieving sustained impact.

Given the political and security situation, and the latter's impact on the delivery/implementation of programmes and projects, all agencies are reviewing their current and future activities. Following the King's action of 1st February at least one, DANIDA, has put a stop to further assistance pending resumption of democratic government. A number increasingly seek to provide assistance directly to beneficiaries or actors in the regions: understandably, it is said this creates some tension with HMGN, which takes a rather different view.

5. CONCLUSIONS AND RECOMMENDATIONS

Nepal's environment is determined by the interplay of physiography, climate, poverty, population growth, institutional weaknesses combined with the infancy of environmental considerations by government, and the decade-long insurgency. Historically, and in much of Nepal to the present time, the steep terrain of the hills and mountains posed formidable transport difficulties. This has resulted in economic isolation to a large degree and perpetuated subsistence agriculture, supplemented by foraging in the forests, as the main economic activity.

About 40% of the population falls below the poverty line and poverty is high throughout the predominantly rural population. The coupling of poverty with the effects of (i) subsistence agriculture, resulting in low nutrition, (ii) limited availability of clean water and sanitation facilities and (iii) reliance on unprocessed bio-fuels and primitive methods for household cooking and heating, contributes to the rural population having especially high levels of morbidity and premature death. Environmental health is poor and diarrhoea-related and respiratory diseases are common, major causes of infant mortality. Rural population growth has largely cancelled out recent increases in agricultural GDP hence the number of people living in poverty has increased. Sustained poverty, coupled with the attraction of greater economic opportunities elsewhere and the desire to escape from the worst consequences of the insurgency, has triggered a substantial migration from rural to urban areas.

Increasing urbanisation resulting from migration and organic growth is a notable, new feature of Nepal's environment, some estimates suggesting the urban population will rise from 14% to 23% of the national total in the ten years to 2011. However, investment in urban, environmental-related infrastructure and service provision has signally failed to match the increase in urban population and density. The results are most clearly seen in Kathmandu Valley, the principal conurbation, whose population has tripled in the past 30 years: the availability and quality of the piped drinking water is wholly inadequate for urban life, air pollution outside the monsoon months is very bad, roads are noisy and heavily congested with traffic, the streams and rivers are heavily polluted with untreated wastewater and solid wastes, the final disposal of solid and clinical wastes is deeply unsatisfactory and though there has been some improvement this year the indications are that this may be a temporary respite only and that in the medium term unsatisfactory arrangements will return.

The need for increased agricultural output and firewood of a growing population has put pressure on the forests, grasslands and wetland habitats of Nepal, and thus on the flora and fauna that depend on these. The agriculturally productive Terai plains are home to a vast array of wildlife and were plagued by malaria up to the 1950s, but, since that time they have been colonised increasingly by migrants from the hills and India: almost half the population of Nepal now lives in the Terai. Major conservation initiatives are in place to protect these habitats and have achieved some success but it is a struggle. Wildlife poaching in reserves and protected areas – of the tiger and rhinoceros especially – has become severe recently, indirectly resulting from the insurgency but a consequence in part of poverty in the proximate areas. Poaching now threatens the achievements over many years of rhinoceros conservation in the Royal Chitwan National Park.

Many areas of Nepal are at annual risk from flash and inundation flooding; also glacier lake outburst floods, GLOF, resulting from climate change (glacier retreat). Nepal's risk rating (UNDP) regarding the vulnerability of its population to flooding is high. Less tangible is the risk of earthquake, and the consequences of extreme and therefore less frequent events of this type. The UNDP's risk rating of Nepal regarding its vulnerability to earthquakes is less severe but the methodology underplays the

significance of a major earthquake affecting Kathmandu Valley. Most buildings are not designed or constructed to withstand earthquake damage and would likely collapse were one to occur as in 1934. Much work on mitigating the worst effects of earthquake damage and on contingency planning is needed to reduce the risk of future disaster in the event of a major earthquake.

Legislative and institutional weaknesses undermines environmental management in Nepal, in particular: (i) a lack of requirement to undertake strategic environmental assessment (SEA) of policies, programmes and plans (ii) no system of land-use planning to coordinate development with environmental considerations and other factors (iii) no quantitative limits on emissions to air from industry (iv) very limited regulatory guidance on minimum acceptable industrial production and pollution abatement technologies (v) no surface water quality standards and no system of river catchment planning (vi) no detailed regulations, standards and environmental safeguards regarding solid and hazardous (including clinical) wastes management (vii) the lack of an agency to effectively inform and implement government policies, monitor and enforce compliance.

Any or several of the environmental-ecological issues and responses identified in Table 2.9 might be adopted and addressed by the EU in a Country Strategy Paper. All are consistent with the goals of HMGN's Sustainable Development Agenda. The challenge for an EU Country Strategy Paper will be to identify and agree value-added initiatives with HMGN (or local NGOs). Priorities must be established, ideally through economic analysis based on cost-benefit principles. In the absence of such analysis only pragmatic, subjective suggestions on priority can be made. Subjective priorities depend on judgements regarding a number of factors such as:

- The relative importance of addressing environmental issues that affect the immediate concerns of the poor in rural areas *or* structural, longer term environmental management issues, which perhaps currently have greater impact on urban areas. This is a profoundly difficulty as these considerations are not so mutually exclusive but supportive, and essential for long-term sustainable development
- Comparing these more tangible issues with minimising the risk of earthquake induced disaster in Kathmandu at some time in the unknown future
- The practical and institutional opportunities and possibilities for intervention.

Rather than trying to rank priorities between the two main issue groups, subjective priorities are assigned within groups in Table s 5.1 and 5.2, respectively. Potential responses to issues are listed in descending rank order (top priority first), noting the objectives of each response (Table 2.9 notes relevant indicators), the sectors involved and the main challenges to be faced. It is recommended that, in preparing its Country Strategy Paper, the EU should attempt to address the top priority issues in both groups. It is recognised that much work will be needed to develop and agree detailed modalities and funding levels.

This CEP was prepared based on a mission of limited duration to Nepal. It should be noted that due to the security situation it was not possible – or at least not prudent – to make field visits outside the capital, Kathmandu; gaining access to Government officials and budgetary information was difficult due to other events taking place at that time; and in the time available it was not possible to hold a workshop to identify collective views on priorities. These factors undoubtedly detract from the robustness of the recommendations for EU action to be pursued in the Nepal Country Strategy Paper.

Table 5.1 Recommended Responses to Rural Environment and Poverty Related Issues

PRIORITY	ISSUE	RESPONSE	OBJECTIVES	SECTORS/INSTITUTIONS	CHALLENGES
1	Households that are unsanitary, proper access to safe water and suffer indoor air pollution	Develop and implement an integrated programme to improve household and nearby environments, with ambitious targets for: sanitation, access to safe water (including As removal in affected areas), and the uptake of technologies to reduce indoor pollution and household firewood consumption	Improved health and reduced mortality; Reduce the burdens of water and firewood collection Stop deforestation	National Planning Commission (NPC), Agriculture, Water Resources, Forests, Health, Industry, MoEST, Finance and NGOs	Programme design and mobilisation of resources to match the scale of the problem; Financial constraints; Securing the insurgents' consent
2	Households and communities having Inadequate access to electricity	Support the development and implementation of an accelerated programme to provide clean electricity in rural communities and households – hydro, solar.	Improve (i) the educational chances for women and children and (ii) economic opportunities	NPC, Water Resources, MoEST, Finance and NGOs	As above
3	Flooding (flash, inundation and GLOF) and landslides	Support the development and implementation of early warning systems, preventive and contingency plans for flood and landslide risks in both mountain/hill areas and the Terai plain	Minimise injuries and the losses of life and livelihoods arising from floods and landslides	NPC, Water Resources, Forests, Agriculture and NGOs	Capacity limitations and mobilising resources
4	Misuse of agricultural chemicals affecting the environment and health	Support strengthened extension (knowledge and training) programmes to foster proper use of pesticides, herbicides and fertilisers in agriculture.	Minimise adverse health effects and environmental pollution (ground and surface water)	NPC, Agriculture, Forests, MoEST, Health and NGOs	Mobilisation of resources, capacity limitations, securing the insurgents' consent
5	Loss of protected, endangered wildlife (rhino's, tigers etc) through poaching	Undermine the economic incentive for poaching by stimulating economic growth in areas adjoining national parks & reserves, partly through fostering a greater participation in and share of the benefits from eco-tourism.	Eliminate or at least minimise the incidence of poaching of endangered, protected species	NPC, Forests and NGOs	Programme design, financial and capacity constraints,
6	Loss of forests and biodiversity through population growth, and the encroachment on natural ecosystems	Support integrated approaches to habitat preservation such as the Terai Arc Landscape Plan and Community Forests programme. Promotion of more efficient wood-burning household stoves (see first priority) should also help reduce firewood demand and deforestation.	Maintain, extend and connect viable natural habitats so that biodiversity is sustained and in harmony with economic development.	NPC, Forests, Agriculture, MoEST, Industry and NGOs	Programme design, financial and capacity constraints,

Table 5.2 Recommended Responses to Environmental Management Issues

PRIORITY	ISSUE	RESPONSE	OBJECTIVES	SECTORS/INSTITUTIONS	CHALLENGES
1	Weak implementation of environmental policy. Urban environmental degradation	Establish a national environmental agency (inspectorate) and develop its institutional capacity for environmental management (air, water, wastes, land) and enforcement of legislation affecting all sectors	A sustainable, effective institution able to inform policy development and to monitor enforce legislation	> HMGN > MoEST	Gaining HMGN support for the MoEST proposal, and its being provided with adequate resources, autonomy and powers
2	Urban environmental degradation – air quality, traffic congestion, waste, rivers	Support the introduction of legislation establishing (a) land-use planning (b) strategic environmental assessment (c) rules and standards for wastes management – capacity building to support implementation	Eliminate or at least minimise some of the proximate causes of gross urban environmental degradation	NPC, MoEST, Physical Planning and Works, Forests, Agriculture, KMC	Introduction of legislation; capacity limitations affecting implementation
3	Poor urban air quality that is injurious to health	Support the development and implementation of integrated urban air quality management strategies addressing impacts and control of emissions from traffic, industrial and other sources – focused on Kathmandu Valley	Air quality that meets national ambient air quality standards for PM_{10} (and other pollutants) - minimise ill-health effects	NPC, MoEST, Health, Industry, Transport, Physical Planning & Works	Institutional capacity limitations
4	Weak legislative basis for industrial pollution prevention and control	Establish minimum (cleaner) technology standards and pollution abatement guidance for potentially polluting industries, and impose associated limits on emissions to air. Institutional capacity building to support implementation	Prevention and control of gross air and water pollution resulting from industrial activity	NPC, MoEST, Industry	Institutional capacity limitations
5	Risk of a major earthquake affecting the Kathmandu Valley (or other major urban centres)	Develop a robust plan for minimising the risk of disaster in the event of an earthquake affecting Kathmandu Valley (building codes, emergency contingency plan and relief) and help initiate its implementation in Kathmandu Valley	Minimise the risk of a future natural and economic disaster resulting from earthquake activity in Kathmandu Valley	NPC, Physical Planning & Works, Health, MoEST, KMC	Institutional capacity limitations
6	Inadequate solid and clinical wastes management	Develop long-term integrated solid and clinical wastes management strategy for Kathmandu Valley, addressing waste (i) arisings/collection (ii) recycling and reuse (iii) wastes treatment and disposal (iv) environmental monitoring.	Implementation of sustainable practices for solid and hazardous waste management - reducing urban pollution	NPC, KMC, MoEST, Physical Planning & Works, Finance	Institutional capacity and financial limitations
7	River pollution and lack of wastewater treatment plants	Introduce river catchment management into legislation; support plan development and WWTP proposals – Kathmandu; capacity building	Sustainable, equitable use of surface waters; prevent river pollution	As above	Institutional capacity and financial limitations
-	Inadequate water supply - Kathmandu	Urgent need but no action proposed in view of the "ongoing" Melamchi project	Ensure proper levels of service: quality & quantity	-	-

Framework Contract AMS/451 Lot N°6
Request for Services N°2005/102913 – Version 2

Country Environment Profile of Nepal

Final Report - Technical Appendices

August 2005

This project is funded by the European Union

A project implemented by MWH

Appendix 1: MAP OF NEPAL

For maps showing districts, physiographic, hydrologic and other features see the NGIIP website, developed with EC support and recently (June 2005) handed over.

Appendix 2: ENVIRONMENTAL POLICIES, STATEMENTS AND ACTION PLANS

POLICY, LEGISLATION, STATEMENT AND ACTION PLAN	DATE
Policies and Plans	
Sustainable Development Agenda for Nepal - National Planning Commission and Ministry of Population and Environment	2003
National Wetlands Policy - Ministry of Forests and Soil Conservation	2003
Terai Arc Landscape – Nepal: Strategic Plan 2004-2014 - Ministry of Forests and Soil Conservation	2004
10th Five-Year Plan: all municipalities required to collect and treat sewage before its disposal	-
The Snow Leopard Action Plan for the Kingdom of Nepal - Ministry of Forests and Soil Conservation and Department of National Parks & Wildlife Conservation with WWF Nepal Programme	-
Legislation	
Environment Protection Act and Rules > IEE or EIA of certain development projects > Pollution control certificates for operating industries > Import permission for certain commodities > Industrial effluent standards: 3 generic and 9 specific	1997
National ambient air quality standards	2003
Nepal vehicular mass emission standards	2000
Vehicular emission standards for in-use vehicles	2000
Ban on polluting vehicles (Vikram Tempo, 2-stroke, 3-wheelers)	1999
Ban on polluting technology in industries (e.g. Bull Trench Kiln)	2004
Surface water quality standards	Preparation
Ozone depleting substances (and consumption) Rules	2000
International agreements (Basel, POPs, Montreal Protocol, Kyoto)	Various

Broad Goals of the Sustainable Development Agenda for Nepal

- Every citizen is able to lead a secure life freely and with dignity
- Every citizen and household has an income that not just covers expenses needed for reasonably health living, but also allows the accumulation of savings and the pursuit of knowledge and leisurely activities
- Every girl and boy child attends school, every adult is literate
- Vocational training is accessible to anyone
- Every citizen is able to pursue higher education based on merit, irrespective of financial circumstances and social standing
- No home in the country is more than a few hours of travel away from basic medical facilities
- Every citizen has easy access to adequate amounts of clean water, nutritious food and clean air
- Most of the nation's energy is generated from domestic renewable sources, including hydro, solar, wind, as well as sustainable harvested and cleanly burned bio-fuel. The transport sector is increasingly powered by domestic renewable energy sources, with continuing efforts to free it from fossil fuel dependence.
- Nepal's hydropower potential is developed not just for domestic consumption but also to provide a steady source of export income.
- Land use is planned and managed at the local and national level such that resource bases and ecosystems are improved, with complementarity between high- and low-lands, that forest biomass grows,

that agricultural and forest lands are protected from urban sprawl, and that biodiversity is conserved at the landscape level by recognising threats from habitat fragmentation and loss of forest cover

- A system of protected areas (including national parks and conservation areas) is maintained and further developed to safeguard the nation's rich biodiversity. Local communities near protected areas are involved in both the management and economic benefit sharing of the area
- Every citizen has adequate availability of forest products to meet his or her basic need, and also has the opportunity to enjoy aesthetic and spiritual experiences in nature.
- The microclimates of hills and mountains are used to produce high-value agricultural products and sustainable production of non-timber forest products for domestic consumption and export.
- Scientific research and domestic industry ensures that Nepal gets adequate benefit from the protection of the genetic diversity of its biological resources
- Domestic scientific expertise on global and regional environmental threats, including climate change, is developed to closely inform Nepal's foreign and domestic policy on those as well as to help adequately prepare for adverse consequences.
- Every Village Development Committee (VDC) is linked to the rest of the country by at least one modern form of transport and communication.
- Viable domestic industries meet at low cost the demand for products of daily household use as well as produce high-value, low-weight products for export.
- Nepal is better integrated internationally and becomes an attractive place for foreign investment. Its natural and cultural heritage is protected and marketed to visitors to generate maximum revenue.
- All citizens, from every culture, ethnicity and religion have swift access to all forms of state services provided by each branch of the state – the executive, the legislature, the judiciary, and all their sub-entities. Institutions of the state represent women and men of all ethnicity and social groups.
- The national development budget is financed largely through domestic resources.
- Foreign aid is limited to specific sectors only, then gradually phased out, first from areas where Nepal can help itself.

These goals are to shape the direction of sectoral objectives and policies.

Table 6.2.1 National Ambient Air Quality Standards (NAAQS) for Nepal, 2003

PARAMETER	UNITS	AVERAGING TIME	MAXIMUM CONCENTRATION IN AMBIENT AIR
TSP	µg/m³	24-hours *	230
PM_{10}	µg/m³	24-hours *	120
Sulphur Dioxide SO_2	µg/m³	Annual	50
		24-hours **	70
Nitrogen Dioxide NO_2	µg/m³	Annual	40
		24-hours **	80
Carbon Monoxide CO	µg/m³	8-hours **	10,000
		15-minutes	100,000
Lead Pb	µg/m³	Annual ***	0.5
Benzene	µg/m³	Annual ****	20

* Limit value not to be exceeded for 95% of time, nor on two consecutive days.

** The standard will not be adopted until MoPE has recommended an appropriate test methodology – expected before 2005.

*** If representativeness can be proven, yearly averages may be calculated from PM10 samples from selected weekdays from each month of the year.

**** To be re-evaluated by 2005.

Table 6.2.2 Selected Tolerance Limits for Wastewater Discharges, Nepal

PARAMETER	MAXIMUM TOLERANCE LIMITS FOR DISCHARGES TO				
	SURFACE WATER				PUBLIC SEWER
	INDUSTRIAL EFFLUENTS			COMBINED WWTP	INDUSTRIAL EFFLUENT GENERIC
	GENERIC	TANNING	WOOL PROCESSING		
pH	5.5-9.0	6.0-9.0	5.5-9.0	5.5-9.0	5.5-9.0
BOD (mg/l)	30-100	100	100	50	400
COD (mg/l)	250	250	250	250	1000
SS (mg/l)	30-200	100	100	50	600
NH4-N (mg/l)	50	-	-	50	50
Oil & grease (mg/l)	10	-	10	10	50
Total Cr (mg/l)	-	2	2	-	2
Cr $^{6+}$ (mg/l)	0.1	0.1	-	0.1	-
Cd (mg/l)	2	-	-	2	2
Phenols (mg/l)	1	-	5	1	10
Cyanides (mg CN/l)	0.2	-	-	0.2	2

BOD biochemical oxygen demand, 5 days at 20 C
COD chemical oxygen demand
SS suspended solids
NH4-N ammoniacal nitrogen
Cr chromium
Cr 6+ hexavalent chromium (the most toxic form in which chromium occurs)
Cd Cadmium

National Parks, Conservation Areas, Reserves and Sanctuaries

They include the Kanchenjunga Conservation Area (CA), Makalu-Barun National park (NP), Sagarmatha NP, Koshi Tappu Wildlife Reserve (WR), Parsa WR, Langtang NP, Manaslu CA, Royal Chitwan NP, Annapurna CA, Shey Phosundo NP, Dhorpatan Hunting Reserve (HR), Royal Suklaphanita WR, Rara NP, Khaptad NP, Katarniaghat Wildlife Sanctuary (WS), Kishanpur WS, Sonanadi WS and Royal Bardia NP.

Appendix 3: HYDROLOGICAL DATA AND INFORMATION ON GROUNDWATER ARSENIC IN THE TERAI

	River - Catchment Area and Monthly Flow (cumec)								
	Mahakali	**Kamali** at Chisa Pani	**Narayani** at Narayan Ghat	**Sapta Kosi** at Chatara	**Babai** at Bargadh	**W. Rapti** at Jalkundi	**Bagmati** at Karmaiya	**Kamala**	**Kankai** at Mainachuli
Drainage Area (km^2)	12,600	42,890	31,100	54,100	3,000	5,150	2,720	1,786	1,148
Jan	100	373	369	383	20	29	18	12	13
Feb	87	337	304	338	16	24	17	11	10
Mar	85	354	285	340	13	20	15	10	9
Apr	105	455	360	416	11	15	17	13	12
May	156	734	595	684	16	16	32	22	23
Jun	379	1,490	1,650	1,590	59	95	214	98	67
Jul	1,097	3,270	4,230	3,490	243	296	539	245	182
Aug	1,507	4,330	5,070	4,020	259	396	513	240	180
Sep	1,097	2,980	3,410	2,980	251	334	338	168	123
Oct	396	1,270	1,530	1,330	98	135	137	69	57
Nov	183	628	779	743	36	55	51	30	27
Dec	123	447	495	501	24	35	27	17	18
Year	**443**	**1,389**	**1,590**	**1,401**	**87**	**121**	**160**	**78**	**60**

Groundwater quality testing since 1999 has revealed the significant but sporadic presence of arsenic (As) in groundwater drawn from shallow tube wells in the Terai. And a health survey in 2001-02 found evidence of arsenic-related dermatitis and elevated arsenic levels in human hair and nail samples in four districts where drinking water contained arsenic at concentrations in excess of 50 ppb (parts per billion). Consequently, some 18,635 tube wells (a fraction of the 800,000 or so wells in existence) were tested for arsenic in 2003, with the observation that:

- 23.7% of the tube wells failed the WHO Guideline value of 10 ppb
- 7.4% of tube wells failed the Nepal Interim Standard of 50 ppb
- The proportion of contaminated wells was highest for those of depth 11 to 30m
- The percentage of wells contaminated above 50 ppb varied at district level from 0% in Dang, Chitwan and Sunsari to 25.7% in Nawalparasi
- About 50% of the wells tested in Rautahat and Nawalparasi districts contained >10 ppb As
- Highest arsenic concentrations – up to 2,620 ppb – were found in Devedaha VDC of Rupandehi district near the border with Nawalparasi
- An estimated 69,000 people in the Terai are drinking water that fails the Nepal Interim Standard of 50 ppb arsenic while 273,000 are drinking water that fails the WHO guideline value of 10 ppb.

Government subsequently initiated blanket testing of tube wells in the Terai and 400,000 have now been tested in ten districts. About 15-20% of samples have been found to exceed the WHO guide-line value. The affected wells are distributed sporadically – if one well is contaminated a nearby well might not – but there is some suggestion that contamination might be associated with the abstraction rate relative to the recharge rate[52]. The blanket testing has also shown that the shallow groundwater is contaminated microbiologically. An absence of funding means that the blanket testing has not been conducted in another ten districts: this is needed so that a long-term strategy for coping with this problem can be formulated. Surveillance of contaminated and uncontaminated wells also needs

[52] Personal communication from Sharad Ahikary of World Health Organisation.

to be undertaken to identify water characteristics over time: it is understood the Department of Geology of the National University is undertaking such a study.

Approaches to dealing with this problem of (naturally occurring) contaminated groundwater are (i) to use an alternative source of water or (ii) household treatment using, for example, a bio-sand filter comprising a bed of iron particles resting on a bed of fine sand. Funding to support the promotion and uptake of household treatment systems is also short. This form of treatment is said to be effective also against the observed microbiological contamination. WHO are working with Government to help improve the diagnosis of arsenic poisoning so as to help get a better idea of its true incidence.

Appendix 4: ENVIRONMENTAL PRESSURES RELATED TO DEMOGRAPHIC TRENDS

DEMOGRAPHIC FACTOR	ENVIRONMENTAL AND ENVIRONMENTAL HEALTH PRESSURES
Population growth	***Rural*** *Agriculture* - increased production of food and cash crops, achieved through a combination of more efficient farming methods and bringing more land into production or use: (i) More efficient farming may involve irrigation, fertiliser use, the application of pesticides and herbicides, and using higher yielding crop strains and animal stock. Inappropriate use of these "technologies" might result in soil quality deterioration in the long-run, surface and groundwater pollution, and adverse health and biotic effects resulting from chemical exposure (ii) Bringing more land into use places pressure on forested land if it is cleared for arable use or (over)grazed by animals, potentially resulting also in soil erosion, land slippage and increased river sediment burdens with potential consequences for downstream flooding and hydropower generation. (iii) Both the above factors also pose threats to biodiversity – fauna and flora: and an extended agricultural land-take may threaten wildlife reserves and corridors. *Energy supply*: To the extent that the rural population's energy needs are and will be met through the use of wood as a fuel – for cooking and heating mainly – population growth will place additional pressure on forests with the potential outcomes noted above *Safe water supply, sanitation and solid waste management*: (i) Access to the basic amenities of safe water and clean sanitation facilities is weak at present. Lack of ready access or where there is access, the service quality is very low, results in poor personal hygiene with adverse consequences for health and well-being[53]. (ii) Non-existent or inadequate management of household, human and agricultural wastes also pose health risks to the wider rural community and risks polluting the land and water environments. (iii) Improved access to safe water is a priority of HMGN but population growth increases the need for all of the services noted here – with adverse impacts if they are not provided. *Development of non-agricultural economic activities* - needed to help facilitate a reduction in rural poverty and improvement in living standards beyond minimum survival needs. Such activities might include tourism, rural crafts, services etc but whatever activities are developed will require associated infrastructures – e.g. energy supply, access roads, buildings. Their location and construction provision needs to be planned sensitively so as not to detract from the local environment – particularly with regard to soil conservation. Growth in the rural population adds to the need for non-agricultural economic growth (pro-poor growth) and planning *Access roads and traffic*: As the rural population expands, greater use will be made of current and future access roads so increasing the traffic on them – increased emissions from road vehicles and increased use and therefore risk of vehicular fuel leakage to environment (land, rivers) from fuel stores

[53] The task of water collection is normally fulfilled by women and children. Since this task may entail a daily journey taking up to several hours the consequences extend beyond a consideration of hygiene (important though that is).

DEMOGRAPHIC FACTOR	ENVIRONMENTAL AND ENVIRONMENTAL HEALTH PRESSURES
Population growth	***Urban*** *Increased demand for urban services:* (i) Clean water supply and management of wastewater and solid wastes – failure to provide adequate access and service quality will contribute to poor hygiene and health, odour nuisance, surface and (potentially) groundwater pollution, localised air pollution from burning wastes and visual (aesthetic) pollution from improperly managed wastes (ii) Energy for cooking, lighting, heating – failure to provide adequate access and service quality will affect peoples' welfare including health and, to the extent that some households and industry resort to using cut wood for fuel, contribute to deforestation *Increased road traffic:* Resulting in congestion, lengthier journeys, vehicular emissions and air pollution (PM_{10}, VOCs, SO_x, NO_x, CO and ozone formation) with implications for health - requires traffic management and planning measures (e.g. public transport, road planning, fuel and vehicular emission standards) to anticipate adverse consequences *Increased demand for construction materials*, especially bricks: Indirectly, this may result in air pollution and associated potential health effects resulting from brick manufacturing plants' emissions to air - if plants are not properly regulated and operated. Brick manufacture may also contribute to forest depletion if wood is cut from the forests and used to substitute for fossil fuels or electricity as the energy source.
Migration from rural to urban areas	***Rural*** Environmental implications are unclear.
	Urban > Accelerated demand for urban services – exacerbating the pressures noted above > Increased road traffic: exacerbating the pressures noted above > Accelerated demand for construction materials, especially bricks – as above.
Economic migration from Nepal to other countries	***Rural*** If it is assumed that it is primarily (young) men who migrate from Nepal for economic reasons, it can be expected that this will increase the physical burdens placed on the women and children remaining at home - with potentially adverse consequences for health and education. Though remittances will help meet needs which can be bought for cash, many activities formerly undertaken by the migrant male will have to be performed by those remaining at home.
	Urban Remittances home from Nepalis working abroad provides further impetus to the construction boom thus indirectly adding to the environmental pressures identified above and add to housing price increases. Migrants may be at increased risk of acquiring HIV-AIDS through sexual transmission or drug-use (needle sharing). On their return they will add to the pool of infection and its potential further transmission in Nepal. The stigma attached to having HIV-AIDS deter testing hence the reported national incidence of 0.3%[54] of the population is likely to be an underestimate[55].

[54] The Himalayan Times (12 July 2005), p. 4

[55] Personal communication from Ram Hari Aryal, Joint Secretary, Ministry of Health and Population

Appendix 5: AIR POLLUTANTS AND THEIR HEALTH EFFECTS

a) Particulate Material

Urban particulate material (PM) suspended in air comprises a range of material including inorganic dust and, especially in finer PM, metals, organic compounds and biological material such as fungal spores and pollen formed around a carbonaceous core. Adverse health impacts resulting from airborne PM include acute respiratory infections (ARI), especially in children; damage to lung defence mechanisms; chronic obstructive pulmonary disease (COPD) especially bronchitis; cardiovascular disease; lung cancer; asthma and eye irritation. Effects are inversely related to particle size and related also to composition (though the nature of the mechanisms involved in the latter is less well understood). Epidemiological studies around the world confirm a statistical relationship between health impacts and PM_{10} concentration and an even stronger association with $PM_{2.5}$. (The suffix indicates the maximum particle size in µm, e.g. $PM_{2.5}$ is the concentration in air of all particles having an aerodynamic diameter of 2.5 µm or less).

- PM_{10} is a measure of the fine particulate material corresponding to the thoracic fraction i.e. those that penetrate beyond the upper nose and throat
- $PM_{2.5}$ is a measure of the fine particulate material corresponding to the reparable particles i.e. they penetrate to and lodge deep down in the respiratory bronchioles in the lung. Children and adults with pulmonary diseases are at high risk.

Impacts in increasing order of severity (and decreasing incidence within an exposed population) are: sub-clinical (subtle) effects, impaired pulmonary function, observed symptoms, use of medication, restricted activity and reduced performance, visits to doctor, emergency room visits, hospital admissions and premature mortality.

b) Nitrogen Dioxide (NO_2)

Nitrogen dioxide is linked with increased susceptibility to respiratory infection such as influenza, increased airway resistance in asthmatics and decreased pulmonary function. Even short-term exposure of children to NO_2 can result in a wide range of symptoms of respiratory problem most commonly, cough, runny nose and sore throat.

c) Sulphur Dioxide (SO_2)

Inhaled SO_2 is highly soluble in the aqueous surfaces of the respiratory tract, causing irritation to mucus membranes and exacerbating asthma and COPD. Effects of low levels of exposure (mean annual levels below 50 µg/m^3 and daily levels not exceeding 125 µg/m^3) on mortality (total, cardiovascular and respiratory) and COPD have been demonstrated consistently.

d) Carbon Monoxide (CO)

Carbon monoxide is formed in the incomplete combustion of fuels containing carbon. CO impairs the oxygen carrying capacity of the blood: foetuses and persons afflicted with heart disease are especially at risk.

e) Ozone (O_3)

Short-term exposure to high concentrations of ozone aggravates pre-existing respiratory diseases such as asthma and increase hospital admission and emergency room visits for respiratory distress. Ozone also causes eye, nose and throat irritation.

f) Benzene

Carcinogenic to humans; long-term exposure can result in bone-marrow depression expressed as leucopoenia and anaemia.

g) Polycyclic Aromatic Hydrocarbons (PAH)

PAH are formed as a result of the partial combustion of organic substances and have a cyclic structure: they comprise a range of related organic compounds and have the potential to produce cancer in humans. One of the most potent PAH is benzo(a)pyrene. PAH mainly adsorb onto the surfaces of PM having a diameter of less than 2.5 $\mu g/m^3$, hence in air at ambient temperature they are mostly present in the particulate phase.

h) Lead

Toxic, affecting the nervous system and blood and impairing the mental development of children; causes hypertension.

Appendix 6: INDOOR AIR POLLUTION – TESTS OF IMPROVED COOKING SYSTEMS AND FUEL USE

Traditional cooking methods involve a basic stove or an open fire underneath a pot supported by a tripod, with minimal ventilation of the kitchen and home: smoke escapes through the roofing, window or doorway. While more ventilation is provided in the Terai due to the hotter climate, the opposite is the case in the high mountains where a fire is needed for keeping warm also.

Studies undertaken for the National Health Research Council (July 2004) provide fuel-specific information on air pollution levels in the kitchen while cooking in the traditional way, and also observed significant differences in health between those exposed to solid-fuel smoke and cleaner fuel users:

FUEL[56]	AVERAGE PM_{10} µG/M^3	AVERAGE CO µG/M^3	INCIDENCE OF COPD AND LRI (%)
Dung	2,840	17,200	16.8
Crop residue	2,690	17,800	
Wood	2,300	14,800	
Kerosene	880	3,680	7.0
Biogas	667	2,090	
LPG	754	1,380	

A number of technologies are being tested and promoted by NGOs in particular to reduce the indoor air pollution problem, including:

- Smoke hoods and flues to vent the smoke out of the home – see below
- Improved cooking stoves (ICS), fitted also with a flue to vent smoke outside the home – see below
- Insulating the home using mud mixed with straw and dung (reducing heat losses and therefore the amount of fuel needing to be burnt)
- Briquette stoves using briquettes of gasified biomass and rice husks mixed with clay
- Use of cleaner bio-fuels – biogas generated locally by anaerobic digestion of animal (and human) wastes – primarily in the Terai where space heating needs are minimal/absent
- Solar cooking – effective but expensive; the parabolic dish has to be tracked to follow the sun; and its use doesn't accord with the custom to eat early and late in the day (no sun).

Smoke Hoods

The NHRC (July 2004) report shows that fitting a smoke hood and venting to the outside reduces PM_{10} and CO levels in the kitchen air to a significant extent: indoor levels for wood burning installations were 785 and 1,570 µg/m^3, respectively. Results from ITDG research activity at Gatlang village at an altitude of 2,200 metres in Rasuwa district to the north of Kathmandu are also positive. Average household size was a little over 6 members: monthly household consumption of firewood ranged from 350 kg in summer to 450 kg in winter: with crop residues also used in winter. Before intervention to fit smokehoods, PM_{10} levels in kitchen air ranged from an average (amongst 31 households)

[56] Indoor levels of formaldehyde (a partial combustion product) were also higher when the solid bio-fuels were burned.

of 760 µg/m^3 in summer to 1,260 µg/m^3 in winter; average CO levels (while cooking) ranged from 12-58 ppm summer to 10-135 ppm in winter[57]. After intervention, PM_{10} and CO levels fell to 589 to 385 µg/m^3 (high summer value may have been due to brewing prior to a festival) and 1-19 to 1-22 ppm, respectively.

Before Intervention

After Intervention

Cooks (women) in all 31 households reported better health and reduced eye irritation following the installation of cooking hoods. Half also reported that homes were warmer following wall insulation but only five said they used less fuel.

Improved Cooking Stoves

Traditional biomass-fuelled fires for cooking etc are very inefficient, only about 10% of the calorific value being usefully exploited. Improved cooking stoves (ICS) enclose the fire – the cooking pot sits on a circular opening on top of the stove - and provide a side-chimney to vent smoke and gases to the outside[58]. The thermal efficiency of the ICS is about double that of a traditional stove[59] with the result that less firewood is needed (half as much, in principle): hence the benefits of ICS should extend beyond a further reduction in indoor air pollution to include reduced deforestation pressure. But the ICS units visited by NHRC (July 2004) didn't appear to have noticeably reduced smoke levels, suggesting some issues may exist in some instances with construction or operation/maintenance.

[57] All photographs and data for before and after intervention (smoke hoods) were made available July 2005 by Jun Hada of ITDG Nepal in a draft paper, "Smoke, Health and Household Energy Project". 15-minute average CO levels reached 195-320 ppm before intervention, falling to 87-173 ppm after intervention: the WHO guideline 60-minute average is 30 ppm CO

[58] Alternative designs – mud-clay through to mud-clay and metal are available depending on whether space heating is also needed.

[59] All thermal efficiency data communicated by Centre for Rural Technology (CRT), Kathmandu, Nepal

Appendix 7: URBAN ENVIRONMENTAL QUALITY AND ENVIRONMENTAL MANAGEMENT, KATHMANDU VALLEY

The population of Kathmandu Valley has grown about three times in the past 30 years resulting in progressively more land coming under development. However, much of the urban environmental infrastructure hasn't kept pace, indeed in some key aspects is largely unaltered, resulting in significant degradation in all environmental sectors.

Water Supply for Household Use

Whilst reported access to a piped supply of water in Kathmandu is close to 100%, this statistic is a gross distortion of reality. Surface water impounded in reservoirs in the surrounding hills is the current source of water used by the Municipal Authority. However, the available resource has been outstripped by the growing demand from a burgeoning population, exacerbated by high leakage rates from the distribution system (reported in excess of 30%). Consequently, the municipal piped water supply meets 33-50% or so of total water demand and is rationed: for most people this means that piped water is made available at best for 30-60 minutes a day, when as much as possible must be collected for storage and subsequent use. Availability can be at any (more-or-less set) time of the day or night, e.g. early morning at 01.00 hrs, hence can be very disruptive and burdensome. But for many, especially outside the monsoon season, supply can be further restricted to 30 minutes or so every two or three days, with obvious implications for toilet flushing and personal hygiene.

Doubts have been cast over the consistency of quality control procedures in the chlorination pretreatment of the water supplied to distribution. Also, because of its restricted use and high leakage rates, much of the water distribution system is part-empty for much of the time and prone to infiltration from polluted groundwater and sewage[60]. Consequently, the piped water that is made available to homes is mostly boiled or filtered before use, resulting in greater household fuel use. The piped water supply inadequacies have driven those who can to sink wells so as to obtain supplemental groundwater. However, this water is also contaminated microbiologically, needing to be boiled before potable use, and there are unconfirmed reports that some of this water exceeds the HMGN standard for Arsenic.

The Melamchi Water Supply Project is aimed at providing a sustainable supply of potable water to the Kathmandu Valley by diverting water through a 26-kilometer tunnel from the Melamchi River in Sindhulpalchowk district. Project components primarily consist of a river diversion and tunnel, a water treatment plant, a bulk distribution system, distribution networks, a groundwater wellfield, and access roads. Completion of the estimated US $464 million project was due in 2005, but a corruption scandal concerning access road contracts has beset the project and completion is now not expected for a further seven years, i.e. in 2012[61]. Given the continued migration into KV, the current water supply situation will get worse in the short-to-medium run.

Urban Wastewater Management

Wastewater generated by households and businesses is either disposed of to sewer (70%) or to septic tanks (30) in some recently developed areas. Many sewers are old, of inadequate capacity, prone to blockage, in poor condition such that ex-filtration (leakage) to groundwater is significant

[60] Water taps delivered "pure" sewage, according to one personal experience related to the consultant.

[61] However, doubts have been expressed in some quarters about whether the project will ever be completed.

and, with the exception of a 17Ml/d wastewater treatment plant discharging to the Bagmati River upstream of the holy site at Pashupatinath, discharge untreated wastewater to the river system. The quality of the Bagmati River is reasonable at Pashupatinath with regard to odour and visual appearance[62], but all downstream tributaries such as the Dhobi Khola and Vishnumati River carry heavy sewage loads[63], as evidenced by their smell, and are seriously contaminated with solid waste: see for example the Vishnumati River in Figure 6.7.1.

Periodically the solids accumulated in septic tanks have to be withdrawn as sludge and disposed of in an environmentally satisfactory manner. However, given the lack of wastewater treatment plants and deficiencies in solid wastes management (see below), such sludge withdrawals that are made are likely to be disposed of to river. Doubts too have been expressed about the performance of many of the septic tanks installed in Kathmandu, their discharges to soil may then (further) affect groundwater and river water quality.

Management of Urban Solid Wastes

A range of methods are used to collect about 260-300 tonne/day of solid wastes generated by households and businesses in Kathmandu: this is additional to the plastic, glass, metal and paper/board segregated by households at source for which they receive a fee from private sector recyclers. Arrangements for disposing of the collected wastes have been fluid over the years but currently comprise (i) disposing of about 70% of the rubbish in “trenches” dug alongside the banks of the Bagmati River and (ii) transporting the other 30% for disposal at a newly opened (June 2005), engineered landfill at Sisdole, located about 28 km by road to the Northwest of Kathmandu. By inspection it is obvious that people living adjacent to streams and rivers have used them as convenient dumping grounds and that, where there is road access, larger-scale dumping may also have occurred – and may still do so. Scavenging of wastes for reusable or recyclable materials also occurs where waste is transferred or disposed of in Kathmandu, but not at Sisdole.

Vishnumati River, a Tributary to the Bagmati River, July 2005

Though ad hoc disposal to trenches in the banks of the Bagmati is due to stop in October 2005, when new trucks for garbage transport are to be delivered, the wastes disposed of to date will result in long-term leachate contamination of the groundwater and, in all likelihood, the Bagmati River[64]. From October, all wastes are due to be transported to Sisdole landfill. However, the approach road extends beyond the area of government control (military checkpoints), is subject to landslide disrup-

[62] No river water quality analyses were found in the mission.

[63] ivestock wastes may be a (minor) contributory factor also.

[64] To the extent that anaerobic conditions prevail, the release and migration of methane may also occur with potentially explosive consequences.

tion in at least one location, and the two cells available are of limited capacity such that they are expected to meet demand for no more than 3 to 4 years. A site with capacity to meet demand for about 25 years is said to be available a further 8 km down the road, but both road and the site will have to be developed and this is threatened by the security situation. There is a significant risk therefore that a reversion to unsatisfactory, unplanned waste disposal arrangements will occur.

Management of Health-Care Wastes

Hospitals and other health-care facilities generate hazardous, clinical waste (body fluids and parts, "sharps" such as needles, drugs etc) and a much larger volume of non-hazardous wastes. Currently there appears to be no effective segregation of the two waste streams; nor any effective method of managing the hazardous component even if it were segregated. Consequently, it must be assumed that hazardous health-care wastes end up in the general urban solid waste stream and disposed of accordingly (see above), with risks for formal/informal waste handlers and water pollution. Officials at the Ministry of Health and Population are very concerned at the current situation.

River Water Quality

As indicated above, rivers and streams passing through the urban areas of Kathmandu valley are seriously contaminated with sewage and solid wastes. No river water quality data were found during the mission but it is understood that 20 or more years ago the Bagmati River to the east (upstream) of Kathmandu was clear, youths would swim in it, and people would catch fish and eat them. None of these activities are carried out nowadays though the waters upstream at Pashupatinath are still taken.

Energy Use

Electricity in Kathmandu Valley is supplied primarily by hydroelectric power stations hence its generation is largely pollution-free. Fuel use, therefore, mainly comprises petroleum products used in the transport sector and households and solid fuels used by manufacturing industry – primarily brick production. Table 6.7.1 indicates the recent growth in hydrocarbon fuel consumption in Kathmandu Valley up to 2000-01[65].

Table 6.7.1 Indicative Growth in Fuel Consumption of Kathmandu Valley

FUEL	CONSUMPTION 2000-01	CONSUMPTION RATIO 2000/01 : 1991/92
Petrol (m^3)	36,600	2.44
Diesel - High Speed (m^3)	54,200	2.51
Kerosene (m^3)	87,800	3.66
LPG (tonne)	30,100	6.68

Transport in Kathmandu Valley

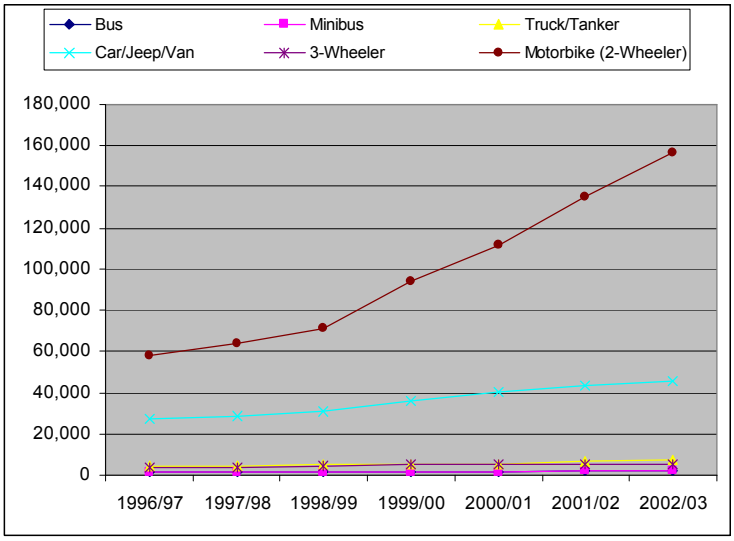
All transport within the Valley is by road on a network of total length 1,339 km[66], amounting to about 10% of Nepal's total road system (disregarding differences in road surface quality). However, this network has to accommodate over 50% of all vehicles registered in Nepal: annual growth in total numbers

[65] IUCN Nepal (2004), "Urban Air Quality Changes and Policy Measures: A Review of Recent Conditions in Nepal", 92 p. LPG consumption in KV is calculated as 75% of the national figure. Petroleum products accounted for 23% of Nepal's import bill in 2000-01

[66] Nepal Health Research Council (2004, July), "Final Report on Assessment of Ambient Air Quality in Selected Urban Areas of Nepal (With Estimated Burden of Disease)", Report submitted by Ambient Air Quality Study Team.

in KV runs at about 16% - even faster in the case of motor bikes, see Figures 6.7.2 and 6.7.3. Consequently, road congestion has increased markedly in Kathmandu: it is aggravated by road conditions, a range of vehicle types and speeds, and disorderly behaviour at traffic intersections. Average speeds on urban roads during peak travel times have fallen over the last ten years from about 25km/hr to less than 10km/hr (IUCN, 2004), while pedestrians experience difficulties in crossing busy roads. Traffic congestion and narrow side-roads populated by pedestrians result in drivers' extensive use of the horn, ensuring that the urban environment is also very noisy.

Growth in Number of Registered Vehicles, Kathmandu Valley (Bagmati Zone)



Typical Road Traffic in Kathmandu (July 2005)

Though it is understood HMGN's plans and policies have given priority to the development of trolley bus transport systems in Nepal, the electrically powered trolley bus service connecting Kathmandu and Bhaktapur was closed in December 2001 after 27 years of operation: operational losses in its final year were Rs 13.1 million[67]. The operation was managed by a state-owned public enterprise, the

[67] Winrock International – Nepal (2002), "Executive Summary of Final Report Study for Revival of Kathmandu – Suryabinayak Trolley Bus System", Report prepared by CEMAT Consultants (P) Ltd

National Transport Corporation, and appears to have suffered from intense politicisation, overstaffing, inflexible bureaucratic norms and low employee morale. This eventually resulted in low operational efficiencies due to a lack of maintenance and spares, vehicle cannibalisation, low vehicle availability, excessive staff costs, and low revenues as a consequence of sub-contracting revenue collection to drivers. Prior to the service's closure, HMGN announced decisions in July 1999 and October 2001 to privatise the unit but did not implement them.

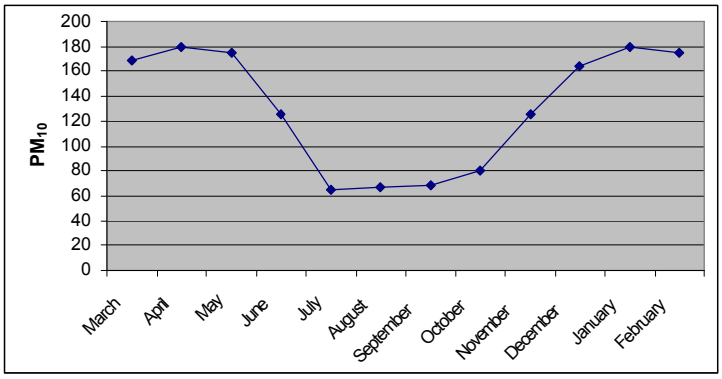
Currently, therefore, Kathmandu's transport needs are met largely by a rapidly expanding number of private motorbikes and cars, supplemented by diesel-powered minibuses and an assortment of slow-speed, three-wheelers powered by LPG or electric[68]. An outer ring road for Kathmandu is under planning at present but the mission was not made aware of any other future transport initiatives affecting KV. In the absence of meaningful land use zoning it can be expected that most of the area enclosed by (and outside) the outer ring road will in-fill over time with randomly located development, reinforcing the difficulties of providing an efficient mass public transport system. In such a scenario, congestion on roads within the outer-ring will induce traffic on to the ring road - leading also to its congestion and reduced effectiveness.

Air Quality and Environmental Health

In contrast to the rural situation, indoor air pollution is much less of an issue in the urban context as cooking is mostly by kerosene or LPG[69] fuelled stoves, and electricity is used for lighting. However, ambient air quality is a significant issue and substantial evidence is now available from donor-funded air quality monitoring (AQM) regarding air pollution levels in KV[70]. PM_{10} is the principal pollutant of concern, based on the degree and frequency of its concentration exceeding the National Ambient Air Quality Standard (NAAQS) value (24-hour average of 120 µg/m^3) and related public health concerns (acute respiratory infection, ARI).

Continuous daily monitoring at 6 sites in KV since March 2003[71] shows a general trend for 24-hour PM_{10} levels to peak from December through to May, a fall to a minimum through the monsoon months of July to September, followed by rising to previous high values.

General Trend for PM_{10} Variation in Kathmandu Valley (2003-04)



The trend is interpreted as resulting from a combination of:

- Impeded dispersion of air pollutants due to the Valley being surrounded by hills which restrict wind movement, and induce thermal inversions in the dry winter months, when air pollutants are trapped in a surface layer of cool air that flows down from the hills

[68] Diesel powered 3-wheelers were banned from Kathmandu Valley in September 1999 and are thought to have been relocated to other urban areas of Nepal.

[69] Better-off Nepalis use LPG (a cleaner fuel than kerosene) but its price has increased by a factor of 3 in the past 12-months, inhibiting its use.

[70] Appendix 6.8 provides detail regarding AQM stations, air pollutants and monitoring frequencies. Appendix 6.9 gives recent air quality monitoring data for Pokhara, Birgunj and some other cities (IUCN, 2004; NHRC, 2004).

- Air pollutants washed out from the air during the monsoon period
- Cessation of brick making activities during the monsoon period.

Location within the Valley matters: outside the city area at Matsyagaon, daily PM_{10} levels exceed the NAAQS limit value on about 6% of days, whilst air quality in urban areas of Putali Sadak, Patan Hospital and Thamel fails the 24-hour standard between 55 and 85% of the time. (A failure rate of 5% in a year is permitted under NAAQS.) 24-hour PM_{10} values at the latter stations can rise to 1,000 $\mu g/m^3$. Depending on the technology deployed and how it is operated, emissions from industries such as cement[72] and brick manufacture[73] can be a local determinant of PM_{10} air pollution, especially in Bhaktapur where brick production is centred. Local people are aware of and oppose the polluting effects of brick kilns. For example, several villages submitted a petition with 434 signatures to government authorities requesting action to relocate brick kilns from their area. Subsequently (December 2001, and presumably in response to a perceived lack of action), village people dismantled 5 kilns and destroyed about 3 million bricks (IUCN, June 2004).

However, empirical evidence supportive of the argument that road traffic is the main source of particulate air pollution (PM_{10} and TSP) in urbanised areas, with the likely exception of Bhaktapur, is rather compelling:

- Air emission inventories made in 1993 and 2001 showing vehicular exhausts and particulate resuspension from roads as a growing and predominant load (cited by MoEST, 2004)
- PM_{10} values and NAAQS failure rate (48%) at the Bhaktapur air quality monitoring station (subject to nearby brick kiln emissions and tending to be downwind of polluted air from Kathmandu) are lower than at the Kathmandu stations heavily affected by traffic
- Significant reductions in ambient air PM_{10} (and CO) levels from a prevailing level of about 125 to 60 $\mu g/m^3$ during a 3-day bandh in September 2003, see Figure 6.7.5 (left)
- Association between roadside 24-hour average PM_{10} levels and 24-hour total motorised traffic count in heavy traffic sites, see Figure 6.7.5 (right).

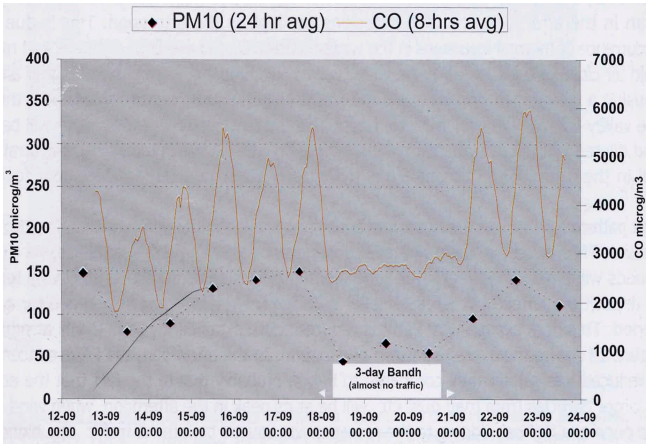
[71] MoEST (2004), NHRC (2004), IUCN (2004) Monitoring continues though its future is in jeopardy following the closure of DanIDA project activity.

[72] The Himal cement plant was a major point source of emissions but is now closed. Cement is now imported.

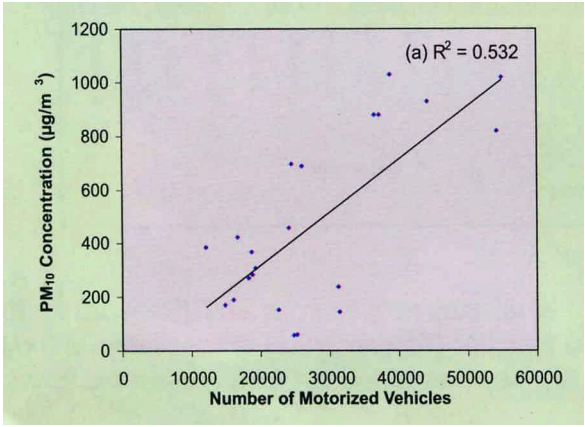
[73] A study conducted in Tikathali VDC in Lalitpur and Jhaukhel VDC in Bhaktapur found PM_{10} levels of 570-600 $\mu g/m^3$ in the brick making season but lower concentration of 160-220 $\mu g/m^3$ in the off-season. A health check-up programme examined the incidence of lower respiratory tract abnormality in young children (under 5-years old) attending (i) High View (School) located adjacent to brick kilns in Tikathali and (ii) Valley Public (School) in Lamatar where there are no brick kilns in the immediate vicinity. This revealed an abnormal respiratory tract incidence of 51% at High View compared with an incidence of 4% at Valley Public. Source: Clean Energy Nepal, "Environmental and Health Impacts of Kathmandu's Brick Kilns", cited by NHRC (2004, p. 9).

Evidence for Vehicular Traffic as the Main Source of Air Pollution

Effect of a bandh on Air Quality (MoEST)

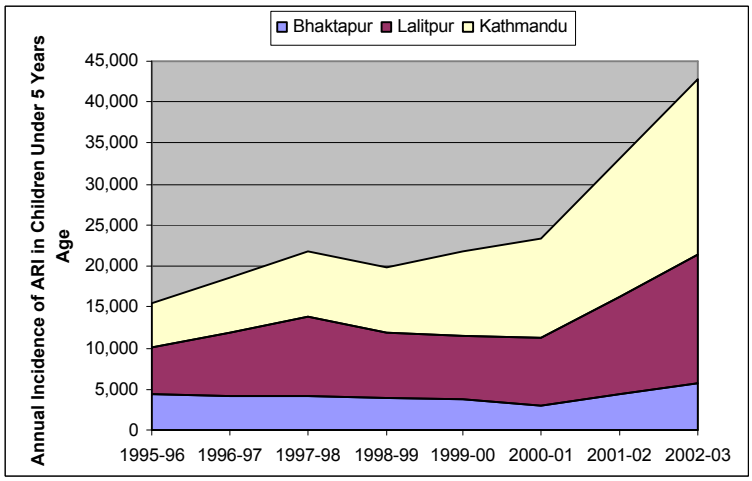


Effect of Traffic Density on Air Quality (IUCN)



Air pollution adversely impacts health, visibility, agriculture, forests, tourism, cultural heritage and the economy[74]. Particulate air pollution (PM_{10} and $PM_{2.5}$) is associated with increased morbidity (asthma attacks, bronchitis, respiratory symptoms, hospitalisation and emergency room visits, lost work/ school days) and mortality, affecting predominantly infants and elderly people with pre-existing cardiovascular and respiratory disease. ARI is a major cause of death of children under the age of five years. Paralleling the growth in vehicular traffic, empirical evidence suggests that, with the exception of Bhaktapur, the incidence of ARI in the young of KV has risen faster than population growth.

Incidence of ARI in Young Children in Kathmandu Valley



Following several earlier assessments made by the World Bank and others, the Ministry of Environment, Science and Technology (MoEST 2004) has made tentative calculations of the excess mortality implications of particulate air pollution in Kathmandu Valley, using the WHO's Air Quality Health Impact Assessment Tool (AirQ2.2.2). The health risk factors used in this model are derived from PM_{10} concentrations some 2-4 times lower than those found in Kathmandu, hence the model's predictions for Kathmandu are essentially extrapolations. Given this caveat, the model output suggests an excess total mortality of 900 per million inhabitants in 2003, and a premature death rate of 1,600

[74] Visibility has declined dramatically since 1980; it has been reported that most people visiting Nepal for more than a day prefer to spend most of their time outside Kathmandu because of air pollution, while a survey of 1,700 tourists in May/June 2001 showed that tourists thought air quality was the prime area for improvement; there is no observed incidence of acid rain in Kathmandu; studies have not been made but it is expected that air pollution will negatively impact the rich cultural heritage (buildings) in KV; economic impacts have been estimated as Rs billions – source IUCN (July 2004).

people per year relative to that if the population-averaged concentration of PM_{10} was reduced to the international standard of 50 $\mu g/m^3$.

Appendix 8: AIR QUALITY MONITORING IN KATHMANDU VALLEY

Air Quality Monitoring Stations

Six air quality monitoring stations have been established by the Ministry of Population and Environment (MoPE), now assumed by MoEST, through the Environmental Sector Project Support (ESPS) programme with assistance from DANIDA. Monitoring of the air pollutants listed in 6.8.1 began in February 2003, PM_{10} and NO_2 being measured routinely while the other pollutants have been measured on a campaign basis. The six stations are:

- Putali Sadak –roadside conditions
- Patan Hospital - roadside conditions
- Thamel – residential conditions
- Bhaktapur – urban background
- Kirtipur – urban background
- Matsyagaon – Valley background

TSP and $PM_{2.5}$

Total suspended particulate (TSP) has been measured every Thursday at Putali Sadak and Patan Hospital AQM stations since January 2003. Monthly average values range between 420 to a 1,000 µg/m^3, exceeding the 24-hour maximum NAAQS limit value of 230 µg/m^3 and implying a very high rate of failure of daily values against the standard. Maximum and minimum values are observed in the dry season and monsoon months, respectively.

$PM_{2.5}$ values have been measured on a campaign basis in 2003 and 2004 so as to identify the $PM_{2.5}$ to PM_{10} ratio (for use of surrogate PM_{10} data in health impact modelling). Average ratios at Bhaktapur and Thamel AQM stations of 0.64 and 0.69 respectively have been observed.

Nitrogen Dioxide (NO_2) Levels

Routine measurements of weekly-average NO_2 levels at have been made since November 2003. Monitoring since then suggest monthly concentrations peaking at 40-45 µg/m^3 at the Putali Sadak station in the dry period of December to May and minimum levels of between < 5 µg/m^3 to 15 µg/m^3 through August-November. While these results show that the annual NAAQS limit value of 40 µg/m^3 NO_2 is complied with everywhere, the measurements are not directly comparable with the proposed 24-hour average NAAQS limit (80 µg/m^3); it is possible that the 24-hour average limit value could be exceeded at locations exposed to heavy traffic emissions in the dry months.

Sulphur Dioxide (SO_2) Levels

Weekly-average levels have been determined on a campaign basis in February-March 2003 and September 2004 at all six AQM stations. Highest March concentrations were observed in Bhaktapur, lying in the range of 55 to 75 µg/m^3; it is presumed that these result from burning high sulphur coal in the brick kilns located in the area. Since these are weekly figures it is likely that some daily SO2 values will have exceeded the NAAQS 24-hour standard value of 70 µg/m^3. Apart from one week at the Patan Hospital station, all other March weekly concentrations were less than 40 µg/m^3 and all September levels were less than or equal to 5 µg/m^3.

Carbon Monoxide (CO) Levels

A two-week monitoring campaign in September 2003 indicated 15-minute average CO levels of 20,000 to 55,000 µg/m^3, in compliance with the limiting NAAQS standard of 100,000 µg/m^3. IUCN

(July 2004) report average concentrations of CO (ppm) at ground and roof top levels for low, moderate and heavy traffic sites. The next table shows that ground level concentrations are higher than at roof tops at moderate-heavy traffic sites.

Average Ground and Roof-Top Concentrations of CO at Low, Moderate and Heavy Traffic Sites (IUCN Nepal, July 2004)

AREA	CO (PPM)	
	GROUND LEVEL	ROOF-TOP LEVEL
Low Traffic	0.38	0.31
Moderate Traffic	0.77	0.39
Heavy Traffic	3.93	1.22

Ozone (O_3) Levels

Ozone is formed by a photochemical process involving the reaction of sunlight with volatile organic compounds. IUCN (July 2004) report average concentrations of CO (ppm) at ground and roof top levels for low, moderate and heavy traffic sites. Table below shows that ground level concentrations are somewhat less than roof top levels, consistent with the observation that sunlight intensity is generally higher at roof-top than at ground level.

Average Ground and Roof-Top Concentrations of Ozone at Low, Moderate and Heavy Traffic Sites (IUCN Nepal, July 2004)

AREA	O_3 (PPB)	
	GROUND LEVEL	ROOF-TOP LEVEL
Low Traffic	23.6	26.9
Moderate Traffic	28.1	32.1
Heavy Traffic	27.9	33.1

Benzene Levels

Weekly-average concentrations have been determined routinely since November/December 2002 with the following average results:

- Putali Sadak –roadside conditions - about 17 µg/m^3
- Patan Hospital - roadside conditions - about 11 µg/m^3
- Thamel – residential conditions - about 10 µg/m^3
- Bhaktapur – urban background - about 5 µg/m^3
- Kirtipur – urban background - about 3 µg/m^3
- Matsyagaon – Valley background – about 2 µg/m^3

Concentrations tend to show some trend to increase in the dry season and reduce in the wet season. All values lie within the NAAQS annual limit value of 20 µg/m^3 but the Putali Sadak station, which is subject to heavy traffic, is close to the limit.

Polycyclic Aromatic Hydrocarbons (PAH) Levels

To a limited extent (18 September and 13-14 November 2003), PAH have been monitored on a campaign basis through its analysis in captured PM_{10} particles. On a normal weekday (13-14 Nov) concentrations at the 6 AQM stations lay in the range 7 to 60 ng/m^3, with the lowest values found at Matsyagaon and highest concentrations at Bhaktapur (the same as reported annual levels found in

Bangkok in 1999-2000). PAH levels were everywhere lower on a bandh day (18 Sep), generally lying in the range of 2 to 11 ng/m^3.

Non-Methane Hydrocarbon (NHMC) Levels

IUCN Nepal (July 2004) report a diurnal variation at Putali Sadak of a number of NMHCs characteristic of petroleum fuel combustion. Monitoring was conducted over a 4-day period in November 1998. Lowest concentrations were observed at night-time and at the weekend.

Non-Methane Hydrocarbon (NHMC) Levels

IUCN Nepal (July 2004) report lead concentrations of 0.01µg/m3 or less, compliant with the NAAQS standard for lead.

Appendix 9: AIR POLLUTANTS IN OTHER NEPALI CITIES

Pokhara

NHRC (2004) report on air quality monitoring at three sites in this tourist town, the gateway to the Annapurna region: (i) subject to heavy traffic in the commercial area (ii) on an industrial estate and (iii) in the tourist and commercial area. An annual population growth of 8% was cited, putting great pressure on urban resources and infrastructure and creating various environmental problems including air pollution. Pollutants determined 15-25 October and 14-22 February included PM_{10}, TSP, NO_x, SO_x and CO. Table 6.9.1 gives the results, showing that particulate pollution is prevalent at all three stations, with failure to meet the 24-hour average NAAQS standard for TSP and either non-compliance with or just meeting the PM_{10} standard.

AQM Results Pokhara (NHRC, July 2004)

PARAMETER	MONTH	WEEKLY AVERAGE CONCENTRATION (µG/M³)		
		SITE (I) TRAFFIC	SITE (II) INDUSTRY	SITE (III) TOUR/COMM
TSP	October	438	487	313
	February	620	300	306
PM_{10}	October	145	149	101
	February	185	111	117
SO_2	October	0.9	0.4	0.2
	February	0.7	<0.3	0.5
NO_2	October	10.5	6.0	7.6
	February	2.4	1.2	<0.8
CO	October	1,800	900	<900
	February	1,800	900	<560

IUCN Nepal (July 2004)report air quality monitoring results for three urban sites in Pokhara, November 2000, indicating PM_{10} values of about 800 µg/m^3.

Eight Cities in the Terai Plain

NHRC (2004) report on air quality monitoring at three sites in the industrial town of Birgunj, with a population of 200,000 (2001 census): (i) subject to heavy traffic (ii) in the industrial area, the roads being unpaved and dusty and (iii) in the commercial/residential area. Pollutants determined 15-25 October and 14-22 February included PM_{10}, TSP, NO_x, SO_x and CO. Table 6.9.2 gives the results. They show that particulate pollution is prevalent - all three stations failing to meet the 24-hour average NAAQS standards for TSP and PM_{10}.

AQM Results Birgunj (NHRC, July 2004)

PARAMETER	MONTH	WEEKLY AVERAGE CONCENTRATION (µG/M3)		
		SITE (I) TRAFFIC	SITE (II) INDUSTRY	SITE (III) COMM/RES
TSP	October	1,099	1,613	572
	February	1,466	1,252	521
PM_{10}	October	303	333	179
	February	457	384	261
SO_2	October	2.7	1.5	0.5
	February	3.7	<0.3	0.3
NO_2	October	16.4	9.2	8.1
	February	4.5	1.8	2.4
CO	October	3,600	1,800	900
	February	1,800	900	900

IUCN Nepal (July 2004) report air quality monitoring results for urban sites in eight Terai cities: Birgunj, Biratanagar, Janakpur, Narayanghat, Butwal, Bhairahawa, Nepalgunj and Mahendranagar, November-December 2000; results indicate PM_{10} values in the range 600-1,400 µg/m^3.

Appendix 10: CLIMATE CHANGE AND GLOFS

Glacial changes may be among the most directly visible signs of global warming, one of the prime reasons why glacier observation has been used for climate system monitoring for many years. Worldwide observations of glacier retreat since the 1950s (and before) are corroborated in the Nepalese Himalaya, e.g. the Khumbu glacier in the Sagarmatha NP has retreated 5 km and the average temperature at 49 stations in the Himalayan region has risen by 1°C since 1973 with the highest elevation sites warming the most and warming being more pronounced in winter. Analysis of precipitation data, however, doesn't reveal any significant trends. Glaciers studied in Nepal include

- Shorong Himal – retreating 30-m from 1978 to 1989, equivalent to a 12-m glacial thinning
- Khumbu Glacier - retreated 5 km since 1953; a lowering of the debris covered surface by 10 m between 1978 and 1995 and a detectable slowing down of the ice flow
- Rika Samba Glacier – retreat of its terminus by about 300 m between 1974 and 1999
- Kanchenjunga Region – a comparison of glacial extent between 1958 and 1992 showed that out of 57 glaciers, 50% were in retreat, 385 were stationary and 12% advancing.

Glacial retreat implies larger river flows if, amongst other things, precipitation patterns are unchanged. Observations are ambiguous in this regard and the time series too short to establish significance. However, studies do suggest that the number of flood days and consecutive days of flood events may be increasing. As glaciers retreat they leave behind voids, previously filled by glacial ice, but now filled by water forming glacial lakes or ponds. The water in a glacial pond or lake is constrained by the moraine walls which act as a dam, but these dams are structurally weak and prone to catastrophic failure triggered by any one of a number of events[75], the end-result being a glacial lake outburst flood (GLOF). GLOFs are characterised by the sudden release of huge volumes of lake water – typically several thousand m^3 per second – that rush downstream along the stream channel in the form of dangerous flood waves comprising water mixed with moraine.

Nepali river discharge may contribute up to 70% of the water in the river Ganges during the dry season, hence significant changes in glacier mass are likely to impact water resources on a regional level. Warmer temperatures in the long-run might result in a diminution of base river flows in the dry season (assuming glacial stabilisation). Continuation of current trends will likely affect other sectors:

- Agriculture – even slight declines in food production would be matter of great concern in Nepal given its growing population. Losses of fertile soil through soil erosion, landslide or flood could bring this about. Effects of potential temperature and precipitation changes on staple crop yields (rice, wheat, maize) are rather ambiguous. Other changes may be more subtle but significant all the same. For example, farmers may find that snowfall in the hills is later and lighter than previously, resulting in less snowmelt, soil moisture and reducing annual planting and cropping from twice to once a year[76].
- Bio-diversity and wildlife – changing climate is likely to affect wildlife habitats and hence the wildlife that depend on them, but it is unclear in which direction change might occur
- Health – a warmer climate might increase the vulnerability of currently sub-tropical and warm-temperate regions to malaria, kalaazar and Japanese encephalitis.

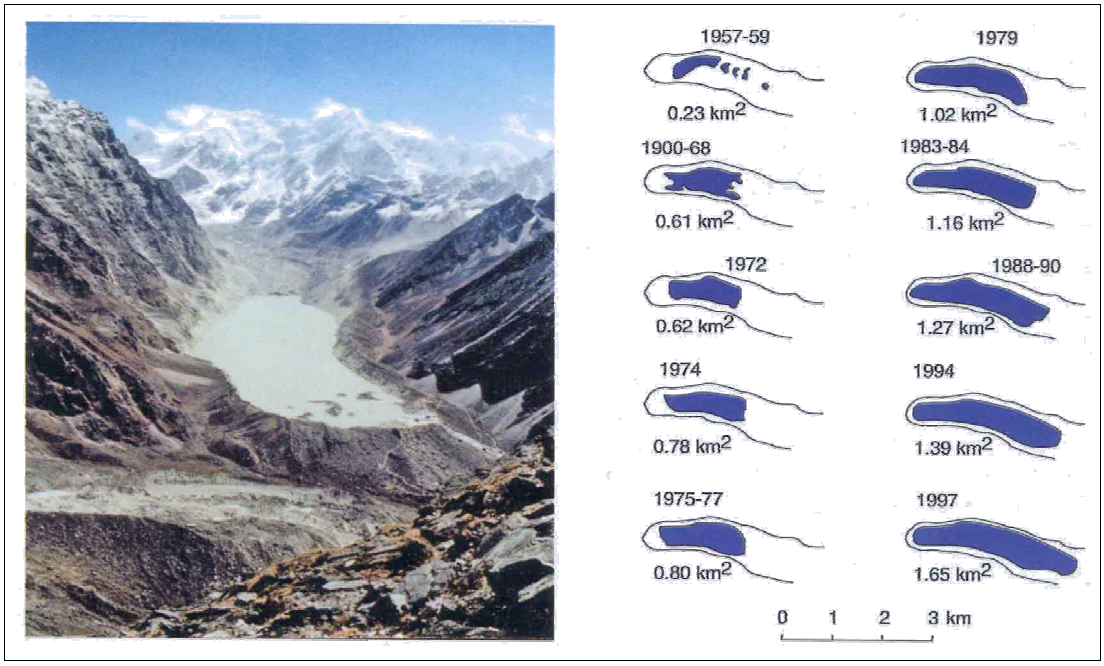
[75] Moraine walls undergo constant changes due to slope failures and slumping; rockslides and snow/ice avalanches into a glacial lake may cause a large displacement wave to sweep over the top of the moraine wall, causing a breach and dam failure; earthquakes may also trigger dam failure either directly or indirectly as described.

[76] Personal communication from Anil Subedi, Intermediate Technology Development Group (Practical Action), July 2005

GLOF Events Recorded in Nepal[77]

DATE	RIVER BASIN	LAKE
ca 1550	Sethi Khola	Machhapuchhare
August 1935	Sun Koshi	Taraco, Tibet
21 September 1964	Arun	Gelaipco, Tibet
1964	Sun Kosi	Zhangzangbo, Tibet
1964	Trishuli	Longda, Tibet
1968	Arun	Ayaco, Tibet
1969	Arun	Ayaco, Tibet
1970	Arun	Ayaco, Tibet
3 September 1977	Dudh Koshi	Nare, Tibet
23 June 1980	Tamur	Nagmapokhari
11 July 1981	Sun Koshi	Zhangzangbo, Tibet
27 August 1982	Arun	Jinco, Tibet
4 August 1985	Dudh Koshi	Dig Tsho
12 July 1991	Tama Koshi	Chubung
3 September 1998	Dudh Koshi	Sabai Tsho

Growth of Tsho Rolpa from 1950s Onwards and Showing its Perched Nature
(WWF Nepal Program 2005, Photo © P K Mool, 2000)



The Dig Tsho outburst in August 1985 illustrates the potentially devastating effects of a GLOF. This 0.65 km by 0.23 km crescent shaped lake was dammed by a terminal moraine wall 50-m in height. The GLOF was triggered by the detachment of a large ice mass from the upper section of the Langmoche Glacier following clear weather in July: the ice mass overran the glacier, dropping into the full lake causing a significant rise in water level. The water overtopped the moraine dam and cut

[77] WWF Nepal Program (2005), "An Overview of glaciers, Glacier Retreat and its Subsequent Impacts in Nepal, India and China"

a V-shaped channel/trench through which the lake's contents of about 8 million m^3 emptied in about four to six hours: flood waters surged 10-15 m high in the valley and the effects were felt more than 90-km downstream. People were washed away; the nearly completed Namche Hydropower Scheme was seriously damaged; cultivated land, bridges, houses and livestock were destroyed.

Framework Contract AMS/451 Lot N°6
Request for Services N°2005/102913 – Version 2

Country Environment Profile of Nepal

Final Report - Administrative Appendices

August 2005

This project is funded by the European Union

A project implemented by MWH

Appendix 11: STUDY METHODOLOGY AND WORK PLAN

NEPAL

i) Introduction, objectives and results

Nepal is one of the world's poorer countries and is rived by conflict, the Maoist insurgency resulting in part, at least, from inequalities in standard of living between communities and a generally low quality of governance. Population growth gives rise to concern, threatening Nepal's fragile eco-systems whilst rapid, unplanned urbanisation causes environmental degradation, especially in the Kathmandu Valley. The consultant presume this factor contributes to the TORs highlighting the need to assess urban, peri-urban and related issues in the State of Environment section of the Country Environmental Profile (CEP) report, though 88% of the 24-million population and most of the poor live in rural areas. The consultant will take counsel from the EC Delegation in Nepal in addressing these issues.

j) Approach

In preparing the CEP the consultant will be as objective as the socio-political situation allows, subject to information availability, but will exercise judgement where credible data are lacking. The consultant will seek, listen to and talk to as many stakeholder representative as possible, not only in Kathmandu offices but in selected field visits. The approach as far as possible will be to identify and assess (i) current environmental conditions, stress points and their causes, and links to poverty (ii) social, economic and ex-country (e.g. global warming) factors placing additional pressures on the Nepalese environment (iii) the potential environmental consequences of these pressures if unchecked (iv) relevant policies, institutions and human resource capabilities (v) appropriate anticipatory and remediation responses including urban infrastructure planning and policy; transport emissions; industrial policy reform and upgrading regarding *inter alia* factory location, health, safety, resource use and environmental protection; and capacity building requirements.

k) Methodology

Relevant, available reports will be reviewed in the desk study phase and the consultant will prepare a preliminary itinerary and list of stakeholders for submission to and subsequent review with the EC Delegation for Nepal.

The consultant will take guidance from the EC Delegation for Nepal and develop the field phase workplan for their review and approval. Activities will include (i) review further, available data to prepare the CEP (ii) review urban infrastructure provision, plans and industrial policy (iii) review environmental policy, legislation, institutional framework and enforcement (iv) review human resources in relevant institutions (v) field visits to inform and verify urban, peri-urban and industrial issues in the Kathmandu Valley (vi) field visits to appropriate rural areas (vii) review potential influence of environmental conditions on the poor, and vice versa (viii) examine linkages between the environment and key sectors and the scope for potential EC support (ix) review prior and existing EU programmes and those of other funding agencies so as to establish lessons to be learnt and guidelines for future programmes and (x) hold a workshop in Kathmandu to review relevant issues and the use of local/international indicators with EC Delegation and other stakeholders.

l) Reporting

Drafting of the CEP will begin during the field phase and will be action oriented: conclusions will be framed logically and recommendations made so as to be easily used in preparing a Country Strategy Paper. The EC Delegation will be briefed towards the close of the field phase and the draft report finalised from home office. After receiving comments on the draft report from the EC Delegation in New Delhi, the final report will be prepared and Brussels desk officer/s briefed if required.

Appendix 12: CONSULTANT'S ITINERARY

DATES	LOCATION	ACTIVITY
20-21 June	Home office	Mobilisation
22-23 June	Brussels	Briefing in Brussels by EC Desk Office
24-25 June	Home Office	Desk study
26 June – 20 July	Nepal	Field Mission including EC Delegation briefing 27-29 June and de-briefing 19th July
21-27 July	Home Office	Draft CEP
26 September – 6 October	Home Office	Revise CEP

Appendix 13: LIST OF PERSONS AND ORGANISATIONS CONSULTED

NAME	ORGANISATION	POSITION	CONTACT DETAILS
Bijaya Man Shercan	Mailun Khola Hydropower Company Pvt. Ltd	Managing Director	P.O Box 8975, EPC 5524, 67 Athak Marg, Kamaladi, Kathmandu-1, Nepal Tel: 4439126 Fax: 4435331, Email: bmsherchan@mos.com.np
Anil Subedi	ITDG (Practical Action)	Country Director	Intermediate Technology Development Group Nepal, Pandole Marg, Lazimpat, PO Box 15135, Kathmandu, Nepal Tel: 4446015 Fax: 4445995 Email: anils@itdg.wlink.com.np
Sharad P. Ahikary	World Health Organisation	National Operations Officer, Environmental Health Programme	Department of Water Supply and Sewerage, Maharajgunj, Kathmandu, Nepal. Tel: 428988 Fax: 419802 Email: sharad@who.org.np
Deva Bhakta Shakya	Agro Enterprise Centre, Federation of Nepalese Chambers of Commerce and Industry	Executive Director	FNCCI Building, Sahid Sukra Milan Marg, Teku, GPO Box 7651 Kathmandu, Nepal. Tel: 4262260/45 Fax: 4261671 Email: agroaec@mos.com.np
Shiva Sharma Paudyal	Royal Danish Embassy	Senior Programme Officer	Royal Danish Embassy, Lazimpat, Kathmandu, Nepal. Tel: 4413010 Fax: 4411409 Email: shipau@um.dk Website: www.denmarknepal.com
Ashok Raj Panday	Nepal Electric Vehicle Industry (P) Ltd	Managing Director	NEVI, PO Box 8975, EPC 5154, Lazimpat, Kathmandu, Nepal Tel: 4436000 Fax: 4427111 Email: nevi@wlink.com
Sagendra Tiwari	IUCN (The World Conservation Union)	Country Director	IUCN Nepal, Bakhundole (Pulchowk), Lalitpur, PO Box 3923, Kathmandu, Nepal Tel:5528781 Fax: 5536786 Email: stiwari@iucn.org.np Website: www.iucnnepal.org
Ganesh Ram Shrestha	Centre for Rural Technology, Nepal[78]	Executive Director	CRT, PO Box 3628, Tripureswor, Kathmandu, Nepal. Tel: 4256819 Fax: 4257922 Email: info@crtnepal.org Website: www.crtnepal.org
Chandra P Gurung	WWF Nepal Program[79]	Country Representative	WWF Nepal Program, PO Box: 7660, Baluwatar, Kathmandu, Nepal Tel: 4430736 Fax: 4438458 Email: Chandra.gurung@wwfnepal.org Website: www.wwfnepal.org
Chirinjibi Gautman	Ministry of Environment, Science & Technology	Under Secretary	Ministry of Industry, Commerce and Supplies, ESPS Programme, Singha Durbar Complex, Kathmandu, Nepal Tel: 4227174 Email: Gautam@esps.com.np

[78] Also Lumin Kumar Shrestha, Director, Email: lumink@crtnepal.org; and Nanda Ram Baidya, Management Advisor.

[79] Also Anil Manandhar, Conservation Program Director, anil.manandhar@wwfnepl.org and Sarala Khaling, Director Development, Research and Monitoring, sarala.khaling@wwfnepal.org

NAME	ORGANISATION	POSITION	CONTACT DETAILS
Kishore Thapa	Department of Urban Development and Building Construction	Project Director	Babar Mahal, Kathmandu, Nepal Tel: 4263406 Email: k_thapa413655@hotmail.com
Gyani Ratna Shakya	Royal Nepal Academy of Science and Technology (RONAST)	Project Director	PO Box 3323, Khumaltar (Lalitpur), Kathmandu, Nepal Tel: 5-547719/15 Email: gyanishakya@yahoo.com
Indira Suwal[80]	Kathmandu Metropolitan City: Environment Department	Chief: Environment and Urban and Solid Waste Management Sections	PO Box 8416, Teku, Kathmandu, Nepal Tel: 4227240 Email: suwai_indra414@yahoo.com
J Gabriel Campbell	ICIMOD – International Centre for integrated Mountain Development	Director General	GPO Box 3226, Kathmandu, Nepal Tel: 5525313/18 Fax: 5524509 Email: gcampbell@icimod.org.np Website: www.icimod.org
Lisa Singh[81]	United Nations Development Programme	Assistant Resident Representative, Environment and Energy Unit	UN House, Pulchowk, GPO Box 107, Kathmandu, Nepal Tel: 5523200 Fax: 5523991 Email: lisa.singh@undp.org Website: www.undp.org.np
Ram H Aryal & Saroj Prasad Rajendra	Ministry of Health and Population	Joint Secretary Public Health Administrator	HMGN, Ramshah Path, Kathmandu, Nepal Tel: 4262935/87 Fax: 4262468 Email: rhayal@infoclub.com.np
Nogendra Sapkota	Asian Development Bank	Social and Environment Officer, Nepal Resident Mission	ADB, Nepal Resident Mission, Srikunj, Kamaldi, Block 2/597, Ward No. 31, Ka Na Pa, PO Box 5017 Kathmandu, Nepal Tel: 4227779/84 Fax: 4225063 Email: nsapkota@adb.org Website: www.adb.org
Sailendra Thakali	Department for International Development	Environment Officer	DFID, Lalitpur, Kathmandu, Nepal Tel: 5542980
Tashi Tensing	World Bank	Senior Sanitary and Environmental Specialist	The World Bank, Yak and Yeti Hotel, Complex, PO Box 798, Kathmandu, Nepal Tel: 4226792 / Fax: 4225112 Email: ttenzing@worldbank.org
Lok Darshan Joshi[82]	Ministry of Environment, Science and Technology	Joint Secretary	Singha Durbar Complex, Kathmandu, Nepal Website: www.mope.gov.np
Bikash Raj Pandey	Winrock International	Country Representative:	Winrock Nepal, GPO Box 1312, Kathmandu, Nepal Tel: 4467087 Fax: 4476109 Email: Bpandey@winrock.org.np
Bibek Chapagain	Kathmandu Electric Vehicle Alliance	In-Country Coordinator	1103/68 Devkota Marg, Baneshwor, PO Box 1312, Kathmandu, Nepal Tel: 4467087 Fax: 4476109 Email: bchapagain@keva.org.np Website: www.keva.org.np

[80] Also: Rajesh Manandhar, Chief Solid waste Management Section, Tel: 4242148/231719, Email: rajeshmanandhar@hotmail.com; and Rabin Shrestha, Tel: 4242148, Email: rms916@hotmail.com

[81] Also Tek Gurung, Environment and Energy Unit, Email: tek.gurung@undp.org and Rahul Sengupta, Disaster Management, Email: rahul.sengupta@undp.org

[82] Also seven professional staff in the Ministry

Appendix 14: LIST OF DOCUMENTATION CONSULTED

- Asian Development Bank (September 2004), "Country Strategy and Program – Nepal 2005-2009"
- Baral, H.S. and Inskipp, C. (2004), "The State of Nepal's Birds 2004", Department of National Parks and Wildlife Conservation, Bird Conservation Nepal and IUCN-Nepal, Kathmandu.
- Department for International Development (2004), "Nepal Country Assistance Plan – Peace Through Development"
- Gurung H. (August 2004), "Landscape Change in the Nepal Hills – Evidence from Lamjung", International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal
- Hada J. (2005), "Smoke, Health and Household Energy Project", ITDG Nepal
- HMGN Department of Forests and Department of National Parks & Wildlife Conservation, "Birds of Terai Arc Landscape – Nepal", published with WWF Nepal Program
- HMGN Ministry of Forests and Soil Conservation (2003), "National Wetlands Policy 2003"
- HMGN Ministry of Forests and Soil Conservation (2004), "Terai Arc Landscape Nepal: Strategic Plan – Broad Strategy Document, 2004-2014", 43 p
- HMGN Ministry of Forests and Soil Conservation (March 2004), "Terai Arc Landscape Nepal: Strategic Plan – Broad Strategy Document, 2004-2014 Summary Report"
- HMGN National Planning Commission and Ministry of Population and Environment (2003), "Sustainable Development Agenda for Nepal"
- HMGN Survey Department and Central Bureau of Statistics (2004), "The Population and Socio-Economic Atlas of Nepal", National Geographic Information Infrastructure Programme (NGIIP) http://www.ngiip.gov.np
- HMGN, National Planning Commission (2003), "The Tenth Plan – Poverty Reduction Strategy Paper 2002 – 2007"
- Hollants J., Looke V. and Philipson L. (2002, January) Report of the EC Conflict Prevention Assessment Mission – Nepal"
- International Strategy for Disaster Reduction (Secretariat, July 2002), "Living With Risk – A Global Review of Disaster Reduction Initiatives", United Nations (Geneva) prepared with support of World Meteorological Organisation and the Asian Disaster Reduction Centre (Kobe, Japan)
- IUCN Nepal (2004), "National Register of Medicinal and Aromatic Plants (Revised and Updated)", xiii + 202 pp. IUCN – The World Conservation Union, Nepal
- IUCN Nepal (2004), "Urban Air Quality Changes and Policy Measures: A Review of Recent Conditions in Nepal"
- Merz J et al (2002), "Water and Erosion Studies of PARDYP Nepal – The Water Demand and Supply Survey", ICIMOD Nepal
- Merz J, (2004), "Water Balances, Floods and Sediment Transport in the Hindu Kush Himalaya – data analyses, modelling and comparison off selected meso-scale catchments", Published by ICIMOD for the University of Berne, Switzerland, Institute of Geography
- National Health Research Council (July 2004), "Situation Analysis of Indoor Air Pollution and Development of Guidelines for Indoor Air Quality Assessment and House building for Health".

- Nepal Health Research Council (2004, July), "Final Report on Assessment of Ambient Air Quality in Selected Urban Areas of Nepal (With Estimated Burden of Disease)", Report submitted by Ambient Air Quality Study Team.
- Richard C., Basnet K., Sah J.P. and Raut Y. (2000) (Editors), "Grassland Ecology and Management in Protected Areas of Nepal. Proceedings of Workshop at Royal Bardia National Park 15-19 March 1999, jointly organised by HMGN Department of National Parks and Wildlife Conservation, ICIMOD and WWF Nepal Programme
- Sharma, T. (November, 2000), "Strategy Paper – Environment Sector – With Special Emphasis on Industrial Pollution, Pollution Prevention, Air Pollution and Solid Waste". Revised Strategy for Danish-Nepalese Development Co-operation
- Shrestha, B.R., Whitney, J.W. and Shrestha, K.B., Editors, (January 2004), "The State of Arsenic in Nepal-2003", National Arsenic Steering Committee, Environment and Public Health Organization, Kathmandu, Nepal, 126 p.
- Stocking M., Helleman H. and White R. (Editors) (April 2005), "Renewable Natural Resources management for Mountain Communities", International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal
- Thapa I. and Karki J.B. (Editors) (2005), "Birds of Kangchenjunga Conservation Area", WWW Nepal Program
- United Nations Development Programme (2001), "Disaster Profiles of the Least Developed Countries", Third United Nations Conference on Least Developed Countries, Brussels, 14-21 May 2001
- United Nations Development Programme (2004), "A Global Report – Reducing Disaster Risk: A Challenge for Development", Bureau from Crisis Prevention and Recovery, www.undp.org/bcpr
- United Nations Development Programme (2005), "Nepal Human Development Report 2004 – Empowerment and Poverty Reduction"
- United Nations Development Programme, Human Development Report 2004: Data hdr_dat_42791489.
- Winrock International – Nepal (2002), "Executive Summary of Final Report Study for Revival of Kathmandu – Suryabinayak Trolley Bus System", Report prepared by CEMAT Consultants (P) Ltd
- Winrock International Nepal (September, 2004), "Report on National Workshop on Household Energy, Indoor Air Pollution and Health in Nepal, 27 August 2004".
- World Bank (2003), "Nepal Country Assistance Strategy 2004-2007"
- WWF Nepal Program (2003), "Hattisars - Managing Domesticated Elephants in Nepal"
- WWF Nepal program (2003), "Snow Leopard in Nepal", prepared in cooperation with Department of National parks and Wildlife Conservation, Nepal and International Snow Leopard Trust, USA
- WWF Nepal Program (2004), "Terai Arc Landscape – Nepal: Fact Book"
- WWF Nepal Program (2005), "Kangchenjunga Conservation Area Project – A Retrospective 1998-2005"
- WWF Nepal Program (March 2005), "An Overview of Glaciers, Glacier Retreat, and Its Subsequent Impacts in Nepal, India and China".
- WWF Nepal Program (November 2004), "Climate change – A Global Concern"