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Nepal CLACC

CAPACITY STRENGTHENING IN THE LEAST DEVELOPED COUNTRIES (LDCs) FOR ADAPTATION TO CLIMATE CHANGE (CLACC)

ADVERSE IMPACTS OF CLIMATE CHANGE ON DEVELOPMENT OF NEPAL: INTEGRATING ADAPTATION INTO POLICIES AND ACTIVITIES

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FOREWORD

Capacity strengthening in the **L**east Developed Countries (LDCs) for **A**daptation to **C**limate **C**hange (CLACC) is a multi country project being implemented by the International Institute for Environment and Development (IIED) in association with four regional centres i.e. the Bangladesh Centre for Advanced Studies (BCAS), the African Centre for Technology Studies (ACTS) in Kenya, the Environmental Development Action in the Third World (ENDA) in Senegal and the Zimbabwe Environmental Research Organisation (ZERO) in Zimbabwe with financial support from a number of development partners.

The aim of the project is to support LDCs in their efforts to adapt to the impacts of climate change through long-term capacity strengthening activities with governments as well as civil society. The main objectives of the project are to a) strengthening the capacity of civil society in LDCs to adapt to climate change and enhancing adaptive capacity among the most vulnerable groups; b) establishing an information and knowledge sharing system to help countries to deal with the adverse impacts of climate change; and c) integrating adaptation to climate change into the work of key non-government institutions, and mainstreaming the National Adaptation Programmes of Action (NAPA) process with these institutions.

Fellows from CLACC regional partners have reviewed existing literature on environment and climate change, priority areas of the government, policies and development plans, and programmes and activities for assessing adverse impacts of climate change on development. It has reviewed the present level of activities and policy domain addressing climate change stimuli including variability and extreme events. The assessment has been carried out for 12 countries spread over South Asia, East Africa, West Africa, and Southern Africa. Apart from this, the assessment report has identified gaps and required measures for integrating adaptation in policies in short, medium, and long-term development activities for addressing adverse climate impacts and reducing vulnerability. The documents used in this assessment are a) initial national communication to UNFCCC, b) reports on climate change impacts, vulnerability and adaptation studies, c) national development policies and plans, d)

poverty reduction strategy papers, e) National Adaptation Programme of Action (NAPA) documents, and e) literature from international sources including UNFCCC IPCC. This assessment report can be used as background material for the preparation of NAPA and mainstreaming adaptation to climate change in other development policies, programme and measures, and to promote sustainable development.

The Nepal Country on "Adverse Impacts of Climate Change on Development: Integrating Adaptation into Policies and Activities" is prepared by Mozaharul Alam, Research Fellow, Bangladesh Centre for Advanced Studies (BCAS) under the CLACC Fellowship Programme. The International Institute for Environment and Development (IIED) has provided the necessary support during the fellowship programme as host institute. Saleemul Huq, and Hannah Reid have provided guidance in the whole process and activities. This was made possible with financial support from the Dexter Trust and Royal Ministry of Foreign Affairs, Norway.

SUMMARY

Nepal is the only Hindu monarchy in the world, with 86.5% of inhabitants in the country practicing Hinduism. It is a land-locked country located in South Asia between India and China, at 28^{o} north latitude and 84^{o} east longitude. It contains 8 of the 10 highest mountain peaks in the world including Mount Everest. It has a very diverse environment, resulting from its impressive topography and extreme spatial climatic variation – from a tropical to arctic climate with a span of about 200 kilometres.

The per capita income of a Nepalese is approximately US$ 250 per annum and is one of the poorest countries in the world, with 82.5% of the population living below the international poverty line of US$2 per day. The size of the national GDP is approximately US$ 5.5 billion with an annual average growth rate of 4.9%. The agricultural sector provided livelihoods to nearly 81% of the labour force in 2000. Despite engaging a majority of the population, agriculture is primarily a subsistence activity and contributes only 38% to the GDP, compared to industry at 23%, and services at 39%. A heavy reliance on tourism and agriculture makes Nepal's economy very sensitive to climate variability.

The priority area for the government of Nepal is to alleviate poverty through implementing a number of programmes. It is reported that the key underlying driving forces of poverty and lack of development are a) high population growth, b) high level of unemployment or under employment, c) prone to natural disasters such as floods and glacier lake outburst d) low level of education, e) lack of job opportunities, f) dependency on natural resources which are deteriorating and becoming fragile, and f) lack of institutional capability. Apart from these challenges, adverse impacts of climate change, variability and extremes would be additional burden for achieving the set goals.

Changes in water sector and flow regime found to be most critical under anticipated changes in climatic system as other sectors will be impacted significantly. Retreating glacier and volume of glacier lake outburst related hazards is growing and presumably it will increase in future. Key water related disasters would be flood, drought, erosion and landslide that may occur with greater frequency or intensity in the

future. Generation of hydroelectricity would be another area of great concern for Nepal unless proper measures take into account in design and implementation of hydropower projects. Higher temperatures, increased evapo-transpiration and decreased winter precipitation may bring about more droughts in Nepal. Decreased precipitation from November to April would impact the winter and spring crops. Rice yields would fall in the Western and Far Western Regions where a greater population of the poor live, threatening food security. Overall it is found that the population living in the Terai plain and hilly areas are more vulnerable than the population in other areas.

The country has identified a number of win-win options and measures in the tenth plan implementation of these option and measures will help addressing adverse effects of climate change. For example, construction of emergency shelters and provision of housing for disaster-affected families have been proposed in the tenth plan under urban development section. Disaster preparedness for the rural households and the agricultural sector and improved management of agriculture is necessary and important in order to reduce the vulnerability to climate change and extreme events.

Acronyms and Abbreviation

ABD	Asian Development Bank
ACTS	African Centre for Technology Studies
BCAS	Bangladesh Centre for Advanced Studies (BCAS)
CBS	Central Bureau of Statistics
CCF	Country Cooperation Framework
CDM	Clean Development Mechanism
CFUG	Community Forestry User Group
CLACC	Capacity strengthening in the Least developed countries for Adaptation to Climate Change
CSOP	Country Strategic Opportunities Paper
CST	Country Study Team
DFID	Department for International Development
DFRS	Department of Forest Research and Survey
DMH	Department of Hydrology and Meteorology
EC	Executive Committee
ENDA	Environmental Development Action in the Third World
EPC	Environment Protection Council
GCM	General Circulation Model
GDP	Gross Domestic Product
GLOF	Glacier Lake Outburst Flood
HMG/N	Her Majesty's Government, Nepal
ICIMOD	International Centre for Integrated Mountain Development
IFAD	International Fund for Agricultural Development
IIED	International Institute for Environment and Development
IPCC	Intergovernmental Panel on Climate Change
LDCs	Least Developed Countries
LI-BIRD	Local Initiatives for Biodiversity, Research and Development
MoA	Ministry of Agriculture
MoF	Ministry of Finance
MoPE	Ministry of population and Environment

MTEF	Medium Term Expenditure Framework
NAPA	National Adaptation Programme of Action
NDC	National Development Council
NPC	National Planning Commission
NSSD	National Strategy for Sustainable Development
NSTs	National Study Teams
NTFP	Non Timber Forest Product
RING	Regional and International Networking Group
SC	Steering Committee
SDAN	Sustainable Development Agenda for Nepal
SRES	Special Report on Emission Scenario
UFCBD	United Nations Convention on Biological Diversity
UFCCD	United Nations Convention on Combating Desertification
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WECS	Water and Energy Commission Secretariat
WSSD	World Summit on Sustainable Development
ZERO	Zimbabwe Environmental Research Organisation

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1 Country Background

1.1 Location and Geography

Nepal is a land-locked country located in South Asia between India and China, at 28° north latitude and 84° east longitude. The boarder line with India and China is 1598 km and 1078 km, respectively. It contains 8 of the 10 highest mountain peaks in the world including Mount Everest. Elevations of the country vary from about 80 meters above mean sea level in the southern plain area (the Terai plain) to 8,848 meters (Mount Everest). It has a very diverse environment, resulting from its impressive topography and extreme spatial climatic variation – from a tropical to arctic climate with a span of about 200 kilometres. Kathmandu, the capital city, is located in the centre of the country.

Source: www.askasia.org/image/maps/nepal1.htm

Nepal is divided into five geographic regions each representing distinguishing characteristics. The five regions are a) the Terai plan, b) the Siwalik Hills, c) the Middle Mountains, d) the High Mountains (consisting of the Main Himalayas and the Inner Himalayan Valleys), and e) the High Himalayas. Characteristics of each region are given in Table 1.

Table 1.Geographic Region of Nepal and its Characteristics

Region	Geology and Soil	Elevation (masl)	Climate	Average Temperature (^{o}C)
Terai	Gently sloping, recently deposited alluvium.	200	Humid tropical	> 25
Siwaliks	Testing mudstone, siltstone, and sandstone. Steep slopes and weakly consolidated bedrock. Tends to promote surface erosion despite thick vegetation.	200-1500	Moist subtropical	25
Middle Mountains	Phyllite, schists, quartzite, granite, limestone. Stony and course textured soil. Conifer forests commonly found associated with quartzite.	1000-2500	Temperate	20
High Mountains	Phyllite, schists, quartzite. Soil is generally shallow and resistant to weathering.	2200-4000	Cool to sub-alpine	10-15
High Himalayas	Limestone and shale. Physical weathering predominates, stony soils.	> 4000	Alpine to arctic	< 0 to 5

Source: CST Nepal, 1997

Land and Population

The total area of Nepal is 147,181 square kilometres with 23.2 million people. It has three distinct ecological regions. The first region, the mountains, consists of mountains and is defined as a mountainous area that lies between the altitudes of 4877 to 8848 meters. This region comprises 35% of Nepal's total land area and inhabits 7.3% percent of the population. The second region, the hills, is defined as area that lies between the altitude of 610 to 4876 meters and it comprises 42% of the total land area. Altogether these two regions comprise about 77% of the total area and inhabit about 51.6% of the total population. The

third and last region, the Terai region, known as the extension of gangetic plains and suitable for cultivation, lies below the elevation of 610 meters. It comprises 23% of the total land area and contains nearly 48.4% of the population (CBS, 2002). It is estimated that the population of Nepal will be between 29.87 and 34.56 million by 2016 against present population (MoPE, 1998). Table 2 provides population size and growth from 1961 to 2001.

Table 2. Population and Growth Rate

Year	1961	1971	1981	1991	2001
Population (millions)	9.4	11.6	15.0	18.5	23.2
Annual Growth Rate (%)	1.65	2.07	2.66	2.09	2.24

Source: NPC, 1997; CBS, 2002

Nepal is the only Hindu monarchy in the world, with 86.5% of inhabitants in the country practicing Hinduism. The remainder is made up of Buddhists (7.8%), Muslims (3.5%), and others. About 50% of the population speaks Nepali, and there are over three dozen other languages spoken. Like many other Least Developed Countries (LDCs), Nepal's development process has commenced relatively recently and has faced challenges of inadequate infrastructure in a highly rugged terrain, little exploitable natural resources, a shortage of skilled labour, low level of industrialization, and a landlocked location.

1.3 Climatic Condition

The climate of Nepal varies from arctic to tropical within the 200 km span from the northern to the southern border. Monsoon climate is predominant and the altitude of a particular region accounts for different climatic regimes. There are four seasons, as defined below:

- Spring (Mar-May)—The weather is dry and hot, with occasional rain showers.
- Summer Monsoon (Jun-Sep)—Very hot, with 80% of annual rainfall.
- Autumn (Oct-Nov)—This short season is warm and humid.
- *Winter (Dec-Feb)*—The climate begins turning cool and dry, and finally cold.

The annual mean temperatures hover around 15°C, and increases from the north to the south with exceptions in the mountain valleys. The annual mean precipitation is around 1800 mm in Nepal. But owing to the great variations in the topography, it ranges from more than 5000 mm along the southern slopes of the Annapurna range in the central Nepal to less than 250 mm in the north central portion near the Tibetan plateau. Terai belt is the hottest part of the country, where the extreme maximum temperature reaches more than 45ºC. The highest temperature ever recorded in the kingdom was 46.4ºC observed in Dhangadhi, a town in far western Terai, in June 1995 (MoPE, 2004). Apart from altitudinal variation spatial distribution of rainfall is also of great concern regarding the occurrence of floods, landslides, and other extreme events. Most floods occur during the monsoon season when heavy precipitation coincides with snowmelt in the mountains. Several major rivers, including the Koshi, Gandaki, Karnali, Mahakali, and the Mechi, flow mostly from north to south and run into the major rivers of the Indian Subcontinent. There are about 6,000 rivers and rivulets, with a total length of 45,000 km.

1.4 Economic Situation

The per capita income of a Nepalese is approximately US$ 250 per annum. The size of the national GDP is approximately US$ 5.5 billion with an annual average growth rate of 4.9%. The agricultural sector provided livelihoods to nearly 81% of the labour force in 2000. Despite engaging a majority of the population, agriculture is primarily a subsistence activity and contributes only 38% to the GDP, compared to industry at 23%, and services at 39%. A heavy reliance on tourism and agriculture makes Nepal's economy very sensitive to climate variability (World Bank, 2002).

Moreover, the economy is experiencing the lowest growth for a decade. The agricultural sector grew just 1.7% in 2002 compared to 4.2% in 2001. Similarly, non-agricultural sectors grew only 0.2% in 2002 compared to 4.9% in the previous year. Tourism arrivals, a large source of foreign exchange for Nepal, saw numbers decline by over 44% due to security concerns in 2002.

1.5 Socio-economic Situation

Despite its natural beauty and enormous potential for hydropower and tourism, Nepal is one of the poorest countries in the world, with 82.5% of the population living below the international poverty line of US$2 per day (World Bank, 2003). A Gini coefficient of 0.37 indicates that income distribution is somewhat uneven. In fact, some 38% of the population survives on less than US$1 per day. The wealthiest 20% of the population claims nearly 45% of total annual national income, while the poorest 20% can claim only 7.6%. Aggregate funding from various international agencies constitutes approximately 45% of Nepal's entire government expenditure (World Bank, 2002).

1.6 Resource Endowment and Condition

The primary physical and environmental resources of Nepal are land, water, forest, and faunal and floral bio-diversity. Hydropower is the primary source of electricity and has a huge potential for future growth. However, it is susceptible to glacier lake outburst due to climate change. The major developments and trends in terms of physical and environmental resources are associated with economic activities, and socio-economic driving forces. The following section provides a brief status of the resource base, status and support to economic growth and livelihoods.

1.6.1 Land and Land use

Land is a principal resource of Nepal and constitutes about 97% of its total area. However, the country's topography is rugged with over three-quarters of the total area made up of mountains and hills (Himalayas, Mahabharat, and Churia) and intermountain valleys. The southern narrow plains strip, known as the Terai, is less than one-third of the total area but supports the largest proportion of the total population. The hills in the country's middle belt are geologically fragile but are favourable for human habitation. The hills constitute the largest area but have a slightly lower population than the Terai, which is spread widely over the entire area.

In Nepal, major land use categories are: forest including shrub 39.6%; agriculture including non-cultivated land 27%; grassland 11.8%; and others 21.6%. Land categorized as forest also includes shrub-land

with less than 10 % crown cover. Of the total forestland, 35 % is in the hills and one-third in the mountain region. The land-use data show 2.97 million ha as cultivated agricultural land, 0.99 million ha as non-cultivated agricultural land, 5.8 million ha as forests (including shrubs), 1.7 million ha as pasture land, and 3.1 million ha of other category (UNEP, 2001).

Agricultural land is the second largest category in terms of land-use and subject to immense pressure. Expansion of agricultural land is a major problem, but it still continues in the attempt to meet the growing demands of the population. Each year, the increasing population has no other way but to count on agriculture and its related activities due to very limited opportunities in non-farm activities. The agricultural land area has increased from 2,376 thousand hectares in 1980 to 2,968 thousand hectares in 1985. Somewhat surprisingly, the agricultural area has been recorded as constant from 1985 to 1999 (MoA, 1999). This might be explained in part by the concomitant loss of agricultural land to housing, roads, and other construction works, or there may be a data collection or definition problem. The per capita agricultural land has declined from 0.16 ha in 1980 to 0.13 ha in 1999. In other words, the person-land ratio (cultivated land) increased considerably from 4.7 in 1971 to 7.5 persons/ha in 1999. In the Terai, the person-land ratio has increased from 3.1 in 1971 to 8 persons/ha in 1999 (CBS, 1999) meaning the Terai area is becoming more populated over the years.

1.6.2 Water and Water Use

Water is the largest natural resource of Nepal. The country's water requirements cover drinking water and personal hygiene, religious activities, agriculture, industrial production, hydropower generation, and recreational activities such as swimming and fishing. There is a growing pressure on water resources due to the growth of the population, expansion of irrigation systems for increasing agricultural production, urbanisation, and industrial expansion.

The Nepal Himalaya revealed 3,252 Glaciers and 2,323 Lakes above 3,500 meters above mean sea level. They cover an area of 5,323 km^2 with an estimated ice reserve of 481 km^3 (Mool *et al,* 2001). It has over 6,000 rivers and streams with an estimated mean annual flow of 4,930 m^3/sec. This amounts to 70% of the total annual surface runoff

of which about 60 to 85% occurs during the monsoon period (June-September). The total available surface water potential (annual runoff) in the country is estimated to be 224 billion m^3. In Kathmandu, the use of groundwater at its current rate appears to be unsustainable, as the total annual extraction is presently estimated at 23.4 million cubic meters, which is greater than the maximum recharge estimate of 14.6 million cubic meters. The effect of groundwater mining and pollution in the Kathmandu Valley is alarming and needs urgent attention (WECS, 2002). The estimated ground water potential in the Terai is 12 billion m^3 of which 5.8 to 9.6 billion m^3 could be extracted annually (estimated recharge) while current groundwater withdrawal is about 0.52 billion m^3 per year (WECS, 1999). The groundwater potential for the country is unclear but probably not much larger.

It is noticed that the surface water and groundwater sources have deteriorated, especially in urban areas. Extraction of groundwater is rising to meet the growing demands of the population for domestic, industrial, and agricultural purposes. It is overexploited beyond its capacity in the Kathmandu Valley (Metcalf, 2000). The water table in the Kathmandu Valley has lowered substantially due to low recharge, which is a result of decreasing forest coverage, increasing urban build-up, and other non-agricultural development activities.

The demand for water for irrigation in the agricultural sector has increased tremendously. The irrigated area expanded from 0.439 million ha in 1984 to about 0.88 million ha in 1998 (MoA, 1999). At the end of ninth plan (2002), the irrigated area has further increased to 1.12 million ha which is expected to increase to 1.37 ha by end of 2007 (NPC, 2003).

1.6.3 Energy and Hydropower

The link between economic development and energy use is closely correlated. It has been noted that not only does energy use increase, but also the share of electricity and other commercially produced energy forms increases with economic development in general. Nepal rely heavily on traditional fuels that are more easily available in rural areas. Nepal's extensive use of firewood has contributed to an alarming rate of deforestation, which increases soil erosion and flooding. A 2001 UNDP study found that the introduction of micro-

hydropower into rural areas produced several benefits, such as time and effort saved on collecting fuelwood and medicines for smoke-related diseases, and children's performances in school improved due to improved lighting.

Energy in Nepal, particularly electricity, is in urgent need of development for rural household use, small village works, and industrial growth. Traditional fuels such as fuelwood and biomass dominate the energy sector in Nepal, accounting for as much as 88% of total demand. Commercial businesses and industry cannot rely on these sources for operation. It is interesting to note, that the industrial sector meets almost 40% of its energy demand through coal, which is entirely imported. As of now, electricity reaches only 15% of the population, primarily in urban areas or on a very small scale in rural areas through micro- and small hydropower. Furthermore, the current electricity supply can meet only *one percent* of the total demand. The National Electricity Authority projects that demand will increase four times in the next 14 years to 5,937 GWh.

Despite having 83,000 megawatts capacity for hydropower generation only 252 megawatts have been generated, i.e., 0.3% of the total potential (NEA, 1999). Electricity consumption has increased enormously over the past 15 years, although the per capita consumption is still only 50 kWh per annum. The domestic sector is the major user.

Hydropower potential in Nepal is a staggering 83,000 MW. The range of economically feasible projects is estimated from 25,000 to 42,000 MW. Given the unsustainability of using fuelwood and its health implications, hydropower is the government's preferred energy source.

1.6.4 Forest

Forests are the largest natural resource in terms of area coverage. A majority of the Nepalese people use the products of forests for firewood, fodder, timber, and medicines. As a result, the forest has dwindled in both area and quality due to the constantly increasing demands of the people for forest products.

About 29% of the area of Nepal is under forest coverage and 10.6% is under shrubs or so-called degraded forest coverage. The forest area, which was 45% in 1966 and 37% in 1986, has declined considerably.

Conversely, the shrub land area doubled from 5% in early 1980 to 10.6% in mid-1990. The annual deforestation rate is estimated to be 1.7% (DFRS, 1999).

About 80% of the total population depend on forests for fuel-wood (WECS, 1997). The fuel consumption for households and industrial biomass is estimated to be 15.4 million tonnes per year for 2000 compared to 11.3 million tonnes per year in 1985. Per capita fuel-wood consumption in the Hills is estimated to be 640 kg, while it is 479 kg/person/yr for the Terai. The per capita timber consumption per annum was estimated at 0.07 m^3/year in 1985 and will increase to 0.11 m^3/year by the year 2000.

Forest products contribute about 42% of the total digestible nutrients (TDN) of cattle. If the present conditions continue, the fodder supply for the TDN requirement will be in deficit by about 0.2 million tonnes by the year 2010 for the country as a whole (HMG/ADB/FINNIDA, 1988).

Between 1986 and 1999 about 0.155 million hectares of forest area were converted to settlement, agriculture, institutional buildings, and roads (DFRS, 1999). Thus, the per capita forest declined from 0.630 in 1964 to 0.442 in 1979 and further to 0.198 hectares in 1998. The forest area in the Terai region declined by 0.1 million hectares between the late 1950s and 1985 due to the planned resettlement programmes undertaken in the forest area. About an equal area of the forest was occupied illegally by migrants for settlement during the same period.

The forest area has also declined due to continued extraction of non-timber forest products (NTFPs). Revenue through trade in NTFPs doubled from a current price of US$ 0.4 million in 1985 to US$ 0.8 million in 1997 (MoF, 1999). Five out of over 100 plant species used in the trade include bojho (Acorus calamus), kutki (Picrorhiza kurroa), padamchal (Rheum emodi), chiraito (Swertia chirayita) and sugandawal (Valeriana wallichii).

In spite of huge pressure on forestry in Nepal, community forestry programme has earned worldwide recognition as a successful programme. His Majesty's Government of Nepal (HMG/N) emphasizes on the important role of forestry sector in the livelihood of people. The rapid advance in community forestry programmes in

Nepal has clearly demonstrated community capability to manage their own resources. Recent data shows that 13,238 Community Forestry User Group (CFUG) has been formed and altogether 1,082,165 ha of forestland is handed over to CFUG. Around 1,481,314 households have been benefited from community forestry and out of total number of CFUG handed over, 642 community forest are managed only by omen (Community Forestry Division, 2004).

1.6.5 Biodiversity

Nepal has a wide variety of plants and animals as a result of its large topographical and climatic variations. With this variety of biodiversity, people have established different levels of relationships with their surroundings for use, misuse, or development. The different biological species play a role not only in establishing symbiotic relationships among themselves in protecting natural resources but also have great economic value. These aspects are yet to be ascertained in detail. However, plants and animals in Nepal are under great pressure as they are considered common property.

Nepal has identified 17 protected areas wherein the protection of species is ensured. These protected areas (national parks, conservation areas, wildlife reserves, and hunting areas), present excellent examples of diverse species of plants and animals ranging from sub-tropical to cold desert climatic species. It is to be noted that the rich biodiversity and natural beauty is one the key factors attracting tourists.

In unprotected public areas, habitats have suffered great threat as a result of loss or alteration, over-extraction, illegal collection of species, poaching or hunting of wild animals, over-grazing, fire, and commercial trade. The economic value of endangered or rare species on the world market is very high which encourages poaching. Nepal, during the last two decades, lost 63 rhinos due to poaching (MFSC, 1997).

1.7 Development Goals and Objectives

The National Development Council (NDC) oversees the process of producing 5-year development plans for Nepal. In addition, the NDC also monitors progress and adjustments following mid-term reviews. The current Tenth Development Plan (2002-2007) sets poverty alleviation as its overarching objective. 38% of the population in

Nepal are currently poor, and the Tenth Plan seeks to reduce this to 30% in the period from 2002-2007. Nepal aims for a 10% improvement in human development indicators and a 6.2% increase in the economy. Nepal's strategy for achieving these objectives are based on the "Four Pillars" of poverty reduction which are a) broad-based economic growth, b) social sector development, including human development, c) targeted programs for underprivileged groups, and d) good governance.

1.8 Brief Overview of Development Planning in Nepal

The National Planning Commission (NPC) is responsible for the preparation of Development Plan for Nepal. The NPC releases annual plans and assesses resource needs apart from formulating 5-year plans for the country's general development strategy. Several other agencies are also involved with development, including the Ministry of Finance (MOF), which is responsible for mobilizing and coordinating foreign aid.

Nepal's planned development began in 1956 with the First Five Year Plan with especial emphasize on building the country's transport and communication infrastructure, which continued until the Fifth Five Year Plan (1975-1980). Meanwhile, a variety of other issues were addressed including energy. The planners were pursuing to develop industry, services and other sectors in order to reduce the dependency on agriculture, which was experiencing a fall in productivity and an increased idle labour. Moreover, a large majority of Nepal's population did not have its basic needs satisfied. This was finally addressed in the Eighth Plan (1992-1997) where the NPC targeted poverty alleviation and reducing regional inequality as two of the main goals (Mishra, 2000). In subsequent years the problems of drinking water, sanitation, health, housing, and primary education were addressed. The National Planning Commission adopted the Tenth Plan (2002-2007) on 17 December 2002 with primary focus on poverty reduction. It is to be noted that the tenth plan is considered the Poverty Reduction Strategy Paper (PRSP) for Nepal.

The primary goal for the next five years (2002-2007) will be poverty alleviation, specifically to bring down poverty to below 30% of the population. At the beginning of the Ninth Plan this figure was 42%. His Majesty's Government of Nepal (HMG/N) plans to alleviate poverty through programs in the following sectors: agriculture;

tourism; communications; financial services and industry; electricity and fuels; strengthening social services; building rural infrastructure; and promoting good governance.

1.9 Development Challenges

It is revealed that the priority area for the government of Nepal is to alleviate poverty through implementing a number of programmes. The key underlying driving forces of poverty and lack of development are a) high population growth, b) high level of unemployment or under employment, c) prone to natural disasters such as floods and glacier lake outburst d) low level of education, e) lack of job opportunities, f) dependency on natural resources which are deteriorating and becoming fragile, and f) lack of institutional capability. These driving forces lead to, among others, an unequal distribution of productive resources and assets, an unequal distribution of income and a low level of human resource development. To these must be added an unbalanced social system, and lack of good governance.

Apart from urgently needs to address the issues of political stability, domestic security and conflict mitigation, which obstruct poverty reduction and economic growth, the main challenge for HMG/N will be to increase the performance of the agricultural sector. In particular, poor farmers need both encouragement to change their practices (for example, to diversify their crops) and improved access to agricultural infrastructure and facilities such as water and credit.

Basic social services in the rural areas should also be urgently improved. The challenge of environmental degradation needs to be tackled through the enforcement of the environmental laws that have already been enacted. Targeting polluting industries and assisting in their relocation are priorities.

Improving governance and diminishing corruption is also a major requirement for enhancing Nepal's development. Good governance is an essential precondition for a fairer and more successful development policy based on comprehensive civil service reforms to increase efficiency and accountability both at central and at local level.

Improving respect for human rights, particularly in the context of the ongoing peace process, is also a challenge, which requires immediate action to rebuild confidence in the Nepali governance.

The private sectors contribution to growth needs to be enhanced in order to create conditions more conducive to new investments, while the progress towards a gradual integration of the Nepalese economy into the global market has to be continued.

Apart from the above mentioned challenges, adverse impacts of climate change, variability and extremes would be additional burden for achieving the set goals.

2 Climate Change, Impacts, Vulnerability and Adaptation

2.1 Changes in Temperature and Rainfall

Studies carried out by the Department of Hydrology and Meteorology show that the average temperature in Nepal is increasing at the rate of approximately 0.06 degrees Celsius per year. The temperature in the Himalayas, however, is increasing at a faster rate, and this has serious impacts on the country's glacial lakes (Raut, 2004). These findings are supported by observations by Liu and Chen (2000) on the other side of the Himalayas, on the Tibetan Plateau. Significant glacier retreat as well as significant horizontal expansion of several glacial lakes has also been documented in recent decades, with an extremely high likelihood that such impacts are linked to rising temperatures (ICIMOD and UNEP, 2002).

The US Country Study of Nepal used records from 22 stations from the 1971-1990. The results for temperature changes with a doubling of CO_2 revealed that the temperature differences are most pronounced during the dry winter season, and least during the height of the monsoon. There is also significantly greater warming at higher elevations in the northern part of the country than at lower elevations in the south (CST-NEPAL, 1997).

There are no definitive trends in aggregate precipitation, although there is some evidence of more intense precipitation events. A somewhat clearer picture emerges in stream flow patterns in certain rivers where there has been an increase in the number of flood days. Some rivers are also exhibiting a trend towards a reduction in dependable flows in the dry season, which has implications both for water supply and energy generation (Shakya, 2003). Glacier retreat also contributes significantly to stream flow variability in the spring and summer, while glacial lake outbursts, which are becoming more likely with rising temperatures, are an additional source of flooding risk.

US Country Studies Program (USCSP) reported that the annual precipitation would increase significantly under a CO_2 doubling condition. It will likely become drier during the dry season, with a significantly wetter monsoon season (as much as three times the

current rainfall). It should be noted that the level of certainty for precipitation projections is less than for temperature. The distribution of rainfall throughout the year is a reliable factor in determining the risk of floods. This pattern of precipitation would likely cause droughts during the winter months and floods during the monsoon.

OECD has recently carried out 17 General Circulation Models for Nepal for assessing changes in the areas average temperature and precipitation using a new version of MAGICC/SCENGEN (software that allow users to investigate future climate change and its uncertainties at the global-mean and regional levels). It has selected 7 out of the 17 models which best simulate current climate over Nepal. The models were run with the Intergovernmental Panel on Climate Change (IPCC) B2 SRES scenario (Nakicenovic and Swart, 2000).

It is revealed from the MAGICC/SCENGEN analysis that there is a significant and consistent increase in temperatures for the years 2030, 2050 and 2100 across the various climate models. Increases in temperatures are somewhat larger for the winter months (December, January, February-DJF) than the summer months. Climate models also project an overall increase in annual precipitation. However, given the high standard deviation the results for annual precipitation should be interpreted with caution. The signal however its somewhat more pronounced for the increase in precipitation during the summer monsoon months (June, July and August-JJA). This is because models estimate that air over land will warm more than air over oceans, leading to an amplification of the summer low pressure system that is responsible for the monsoon. These results are broadly consistent, though more pronounced than the Country Study for Nepal that was based on outputs from four older generation Global Climate Models (GCMs) (Agarwala et al., 2003).

Table 3. GCM estimates of temperature and precipitation changes for Nepal, OECD, 2003

Year	Temperature change (°C) Mean (standard deviation)			Precipitation change (%) Mean (standard deviation)		
	Annual	DJF	JJA	Annual	DJF	JJA
Baseline Average				1433 mm	73 mm	894 mm
2030	1.2 (0.27)	1.3 (0.40)	1.1 (0.20)	5.0 (3.85)	0.8 (9.95)	9.1 (7.11)
2050	1.7 (0.39)	1.8 (0.58)	1.6 (0.29)	7.3 (5.56)	1.2 (14.37)	13.1 (10.28)
2100	3.0 (0.67)	3.2 (1.00)	2.9 (0.51)	2.6 (9.67)	2.1 (25.02)	122.9 (17.89)

Note: Figure within parenthesis is standard deviation

Thus based on this analysis there is a reasonably high probability that the warming trend already observed in recent decades will continue through the 21st century. There is also a moderate probability that the summer monsoon might intensify, thereby increasing the risk of flooding and landslides with subsequent impacts on agriculture and livelihoods.

2.2 Impacts, Vulnerabilities and Adaptation

Nepal's low level of development and complex topography leaves it quite vulnerable to climate change. The studies mentioned above identified five key sectors that are vulnerable to climate change.

2.2.1 Water Resources

It is revealed from the studies that the changes in temperature and precipitation will alter the hydrological cycle and the water resources. The monthly variability of runoff is quite high in Nepal, for example, with the Sapta Koshi varying from 400 m^3/sec in February to 4300 m^3/c in August. Mean monthly discharges show that global warming would shift the peak discharge month from August to July, due to the fact that the snow cover on mountaintops would melt earlier. This could lead to increased flooding and more pronounced variations in water availability throughout the year. In some areas, drought could become a problem.

Geoscientists have noted that, with glaciers retreating due to global warming, the number and volume of Glacial Lake Outburst Flood (GLOF) hazards is growing. Some of these floods have produced discharge rates of up to 30,000 m3/sec and can run for distances of 200 km (Richardson and Reynolds, 2000). Considering the average vertical lapse rate of 6.5°C per kilometer, it was found that almost 20% of the present glaciated area above 5000 meter altitude are likely to be snow and glacier free area with an increase of air temperature by 1°C. Similarly, 3°C and 4°C rise in temperature could result into the loss of 58% and 70% of snow and glaciated areas respectively. Such changes are likely to contribute to the faster development of glacier lakes leading consequently to the increase in potential of glacier-lake outburst flood hazards. Also, increase in precipitation by more than 20% is likely to cause significant increase in sediment delivery, and more than 20% increase in annual sediment deposit could be expected in a scenario of 50% increase in annual precipitation (MoPE, 2004).

In the past, GLOF have caused enormous destruction. The most significant documented GLOF event occurred in 1985 and resulted in extensive damages. This GLOF caused a 10 to 15 meter high surge of water and debris to flood down the Bhote Koshi and Dudh Koshi Rivers for 90 kilometres. At its peak, 2,000 m3/sec was discharged, two to four times the magnitude of maximum monsoon flood levels. It destroyed the Namche Small Hydel Project, which was almost completed at the time and cost approximately NPR 45 million. With limited opportunities for safe and sustainable livelihoods in the mountains, population densities are growing within the river valleys where the vulnerability to GLOFs increases. The population growth means that there are now more people exposed to GLOFs and other climate-related disasters, and this is compounded by the expansion of infrastructure and settlements in the vulnerable areas.

From 1954 to 2002, floods have affected over a million people in Nepal. Floods have killed 5,003 people (24% of deaths from all disasters), left almost 70,000 homeless (45%), and caused damages amounting to US$990,613 (75%) (Vivian, 2003). Floods, and other climate-related disasters such as drought, extreme temperatures, and windstorms, may occur with greater frequency or intensity in the future. Heavy rains often trigger devastating landslides, which are another huge concern for Nepal. Disasters severely disrupt livelihoods

and community development, whether they are flash floods or slower onset events, such as drought. In fact, droughts can affect a greater number of people, and often no assistance is provided until it is very late. By that point, many families may have sold off their productive assets, and they are left in a precarious state.

2.2.2 Hydropower

Climate plays a large role in determining the feasibility of hydropower projects, since the potential change in precipitation and temperature is likely to affect runoff. This affects the potential electricity generation and the benefits of establishing or continuing to operate a hydropower plant. Extreme events such as GLOFs have the largest potential affect on plants, as the force of a GLOF is so great that an entire plant can be wiped out in a very short period (Vivian 2003, Agarwala *et, al.,* 2003)

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These climate concerns span a variety of time scales, ranging from seasonal to interannual variability. The key impacts of climate change on the hydropower sector identified include:

- Increased GLOF hazards
- Increased variability of river runoff (increased during monsoon season, decreased during dry season)
- Increased sediments
- Increased evaporation from reservoirs
- Impacts on watershed

In addition to GLOFs, the greatest impact on hydropower will be the increased variability of river runoff. Two factors will contribute to this: 1) glacier melt, and 2) precipitation patterns.

Hydrologists in Nepal agree that runoff will initially increase as glaciers melt, then later decrease as deglaciation progresses (Shrestha, 2003). In addition, decreased winter snowfall means less precipitation would be stored on the glaciers, so this would in turn decrease the spring and summer runoff. Winter runoff, on the other hand, would increase due to earlier snowmelt and a greater proportion of precipitation falling as rain. This interannual variability would affect the operating efficiency of plans. For example, a study on the dependability of flow throughout the year in the Bagmati River shows

a long-term average of 21.1 m^3/sec 92.3% of the time. Under the scenario of doubled CO_2, however, it will be only 7.43 m^3/sec. The current range of the Bagmati is 316.26 m^3/sec, which is projected to increase to 810.37 m^3/sec.

This poses considerably more complexity for hydropower planners and engineers in maintaining electricity generation throughout the year. It will require additional considerations in plant designs to accommodate the greater range of runoff, in addition to the likely increase in sediment loads.

Landslides and debris flows are highly dependent on precipitation levels. Shakya (2003) points out that approximately 20% of the rainfall transports 90% of the debris volume in Nepal. With the intense rainfall projected for the monsoon season, sedimentation is another factor that may shorten the operating life of a hydropower plant.

2.2.3 Agriculture

The agricultural sector is highly dependent on the weather, and given the low productivity increase of the last few years compared to population growth, climate change is likely to have serious consequences for Nepal's agriculture. Most of the population is directly dependent on a few crops, such as rice, maize, and wheat. Decreased precipitation from November to April would impact the winter and spring crops. Rice yields would fall in the Western and Far estern Regions where a greater population of the poor live, threatening food security.

With the dependency on agriculture, over 80% of all water in Nepal is used for irrigation. Higher temperatures, increased evapo-transpiration and decreased winter precipitation may bring about more droughts in Nepal. In addition, as discussed above on hydropower, many rivers may face highly variable flows with climate change. Studies in Southwest Asia show that decreased winter snowfall on glaciers does indeed decrease the spring/summer runoff. This has already caused severe droughts in Iran and Pakistan in areas that depend on water from mountain sources (Subbiah, 2001). Increased variability would severely impact irrigation and the farming livelihoods dependent on it. The land that can be cultivated varies by

location and season, since the vast majority of surface water irrigation systems in Nepal depend on the water flowing at its source (CST-NEPAL, 1997). In some cases, the winter cropping area is only 20% of the cultivable area during the summer.

Vulnerability assessment of rice yield showed that at 4°C temperature and 20% increase in precipitation, there could be yield increase only from 0.09 to 7.5% and beyond that the yield would continue to decline. However, temperature rise had mixed reaction in the case of wheat as the actual yield of wheat showed increased output in western region of Nepal with the rise of temperature but decline in other regions. Similarly, temperature rise had negative effects on maize yield as it was found to decrease with increase in temperature. Though temperature rise and more negative effects on maize yield, the trend was almost similar to wheat. However, rice, wheat and maize responded positively under double CO^2. Wheat potential went as high as 60%, rice yield 21% and maize yield 12% under double CO^2 condition (MoPE, 2004).

2.2.4 Forestry and Biodiversity

Forest has been shrinking in Nepal mainly due to human activities. Terai forest has decreased at an annual rate of 1.3 %, while hill forest has decreased at the rate of 2.3 % from 1978/79 to 1994/95. In the whole of the country from 1978/79 to 1994/95, forest area has decreased at an annual rate of 1.7 %, whereas forest and shrub together have decreased at an annual rate of 0.5 % (FRISP, 1999). The draft national communication notes that vegetation patterns would be altered by changes in temperature and precipitation, which in turn would affect biodiversity in forests. Nepal has a striking variety of species, including 60 that are currently endangered. One study has found that 2.4% of biodiversity may be lost with climate change.

2.2.5 Health

Increased disasters, particularly from floods related to glacier melt, would have a direct impact on health. Diseases such as malaria. Kala Azar and Japanese encephalitis may also move to new regions, or the area where they thrive may expand in the future. The current lack of primary healthcare for large portions of the population also contributes to their vulnerability to future climate change.

Like in many other developing countries, urban centres in Nepal are also expanding quickly. Over 10% of the population now lives in urban areas, and the number is growing by about 5% per year. In 2000, Kathmandu experienced a water stress of approximately 60 million m^3 and a water scarcity of 40 million m^3. Ensuring adequate water resources for all of the country's various uses will become an increasingly urgent issue, especially with the added impacts of climate change.

2.3 Impacts on Development and Livelihoods

Climate change impacts will affect Nepal through a number of pathways, including disasters, hydropower, irrigation, and domestic water usage. These changes could place additional burdens on the development activities and livelihoods of communities. There is a high level of probability that in the coming decades many glaciers will retreat and smaller glaciers disappear (IPCC, 2001). The most pressing risk for Nepal stems from the potential increase of climate-related disasters, particularly of GLOFs. Nepal is especially vulnerable to GLOFs in the future because of the numerous glacial lakes located along the Himalayas. A study by the UNEP and the International Centre for Integrated Mountain Development (ICIMOD) was completed in 2001 to inventory glaciers and glacial lakes in Nepal and Bhutan. It found over 3,252 glaciers, 2,323 glacial lakes, and 20 potential GLOF sites in Nepal (UNEP, 2002). An analysis of records of glacier fluctuations in the Hindu-Kush-Himalayan region over the past 150 years shows that, while examples exist of both advance and retreat, the glaciers have mostly been retreating (Chalise, 1994). GLOFs have been described as a *"...catastrophic discharge of large volumes of water [resulting] from the collapse of unstable natural dams formed when stream channels are blocked by rockfall, landslide, debris flow, or ice and snow avalanches. Another cause is the outburst of lakes dammed by glacier ice or by glacier moraines…Depending upon the availability of loose material, the outbursts may be flood surges with a high sediment load, or actual debris flows."*

2.4 Adaptation Options

It is revealed from several climate change impacts and vulnerability assessment studies that Nepal's vulnerability is highly associated with the changes of water regime. A number of adaptation options and

measures have also been identified under three broad categories and each options would have varying degrees of effectiveness in securing Nepalis' development and livelihoods, and of course, there are varying costs associated with them (Vivian, 2003, Agarwala *et, al.,* 2003). The identified measures are as follows.

2.4.1 Soft Measures

The identified soft measures are win-win measures or no regret measures and many of these would help to reduce vulnerability, and would provide benefits regardless of climate change.

- ***Improve Observation and Forecasting***—The remote access to many areas leaves the climatological record sparse, especially above 2,500 m. There are often gaps in the data for the stations that do exist. Department of Hydrology and Meteorology (DHM) manages 263 meteorological stations and 47 hydrological stations in Nepal. More and accurate information is needed for better forecasting, which can then be incorporated into early warning systems. Installation of equipment would be high cost with high effectiveness.

- ***Develop Early Warning Systems***—In conjunction with an engineering project from 1998-2002 to reduce the risk of a GLOF occurring on Tsho Rolpa, an early warning system was simultaneously established in 19 villages downstream of he Rolwaling Khola. Local villagers have been actively involved in the design of this system, and drills are carried out periodically. Warning system involving the community can be replicated with adjustments by incorporating lessons learned and spatial and social circumstances. This option appears to be high cost with high effectiveness.

- ***Hazards and Vulnerabilities Map***—A joint project between UNEP and ICIMOD produced an inventory of glacial hazards in Nepal and Bhutan. A UK project to conduct a vulnerability assessment of glacial hazards has been postponed. For both hazards and vulnerability, continuous monitoring is needed to keep the maps updated. Effectiveness of this option is moderate to high with moderate cost.

- ***Increase Community Awareness and Participation***—Incorporating practices from traditional water and natural resource management can raise the chances of successful climate change adaptation. Existing programs to promote community based disaster management stress the importance of creating ownership, making effective use of village events, and involving key stakeholders. This measure also enhances the community's capacity to manage and implement general development programs. This option is highly effective with low cost.

- ***Promote Forestation and Conservation***—From 1979-1998, Nepal's forested area decreased by one third. Planting protective forests can increase water availability in dry season, reduce landslides and erosion, and enhance biodiversity. It will also help to sustain the natural resource base, which attracts tourists to the country.

- ***Promote Water Conservation and Market-based Water Allocation***—These measures would increase the efficiency of water allocations and allow more rapid and flexible responses in the future.

- ***Increase Irrigation Efficiency***—Using sprinklers would increase the surface irrigation efficiency by 50%. However, it involves greater capital investments and is not suitable for paddy cropping. Installing drip networks to supply water directly to the roots is another measure, but it is only feasible for extremely dry conditions due to the high costs. The increased efficiency could help to expand the irrigated area.

2.2.4 Hard Measures

The hard adaptation measures include engineering projects to reduce vulnerability, particularly to floods and drought. These are typically more expensive measures that address a specific problem, but they can also produce multiple uses and benefits. The identified measures include:

- ***Mitigate GLOF Risks***—Experts recommend several methods, including draining by siphon or pump, cutting a drainage channel for periodic water release, and building flood control measures downstream to mitigate the effects of a flood

(Rana *et, al.*, 2000). These all have their disadvantages. Pumping is expensive — because of the remote location, everything must be flown up to the site. Flood control measures are less desirable because Nepal's topography makes the flood behave unpredictably as it moves downstream, and in effect, it is treating the symptoms rather than the cause. With the support of The Netherlands, HMG began a project to drain the Tsho Rolpa glacial lake by three meters, which reduced the risk of a GLOF by 20%. A channel was cut into the moraine, and a gate was constructed to allow water to be released as necessary. The four-year project cost US$ 3.2 million.

Certain GLOF mitigation measures can provide additional benefits, such as micro-hydropower and export (of major hydroelectric power generation facilities) (Reynolds and Richardson, 1999). Siphoned water could also be used to supplement dry season flows, maintain adequate water levels in downstream ecosystems to protect valuable fish stocks, and supply water for local usage. However, the long-term economic feasibility of multi-benefit schemes requires further study.

- ***Expand Irrigation and Storage***—The Tenth Plan aims to develop the necessary infrastructure in order to provide the facilities in the irrigable land with water in all seasons by utilizing the country's existing water resources. The total budget allocated for irrigation is US$ 307.8 million over five years. Detailed information on prioritised projects and estimated costs are available in the Tenth Plan.

- ***Include Reservoir Hydropower for Electricity Development***—One advantage of large hydropower reservoirs is that these reservoirs can provide dependable flows for electricity generation, supplement water supplies for domestic and agriculture uses during the dry season, and if properly designed, play a role in flood management. These possible benefits must be carefully weighed against the environmental impacts and the enhanced GLOF risks.

2.4.3 Institutional Issues

The Nepali Ministry of Population and Environment (MOPE) is the focal point for the United Nations Framework Convention on Climate Change (UNFCCC) and coordinate climate related activities in the country. A few cross-cutting capacity building needs identified for adaptation options include:

- Lack of information and data—Research is often cited regarding climate change and sustainable development issues.

- Lack of public awareness—Addressing this may be the most effective way to reduce vulnerability to climate change and increase the effectiveness of adaptation options.

- Need for inter-departmental coordination—Building rural infrastructure, developing high valley agriculture, and building hydropower plants calls for a better coordination among the different departments. Dialogue should also be maintained with community-based organisations working on rural development and sustainable livelihoods.

- Need for regional collaboration—GLOFs often originate outside of Nepal, such as the 1981 event that closed the highway to Tibet for over a year. The solutions to tackling these problems will often require regional cooperation and information sharing about watersheds. Furthermore, comprehensive river basin or lake/reservoir management to address both climate change and future growth are needed.

- Need for international partnerships, capacity building, and assistance—International assistance will be required not only for funding, but also in terms of technical expertise and human resource development.

3 Mainstreaming Adaptation to Climate Change

A recognition, by both national and international agencies, of the adverse impacts of climate change and extreme events on future development and an incorporation of this awareness in policy and strategy documents, can be seen as the beginning of mainstream adaptation to climate change. The next step is a shift from policy to action and integration with existing development programmes and activities, which is not an easy task. The shift from policy to action needs participation of and cooperation from different stakeholders (government policy makers, implementing agencies, development partners, private sector, and communities). The following section will review the present status in terms of recognition of adverse impacts of climate change in policies, strategies and actions being implemented to address climate change, variability and extreme events. It will also review the status and process regarding the preparing of the National Adaptation Programme of Action in Nepal, as urgent and immediate actions need to be incorporated in the context of development and livelihoods.

3.1 Present Policies and Activities

3.1.1 Climate Change Concerns in Planning Documents

The Tenth Plan has been developed as the country's Poverty Reduction Strategy Paper (PRSP) to address poverty and development. Even more than in the previous Ninth Plan, poverty reduction is the central focus of this new development strategy. The Development Plan is accompanied by a Medium Term Expenditure Framework (MTEF), which provides a prioritisation of resources and ensures consistency of annual budgets with the 5-year Development Plan.

The current concept paper for the Tenth Plan acknowledges the important ***influence weather*** can have on overall economic performances. However, only one paragraph in the whole document mentioned the development impacts of weather and climate. Many of the proposed development activities will enhance the adaptive capacity of individuals, communities, and the country as a whole and thus may well reduce vulnerability to climate risks, but explicit attention to these risks is missing. Exploration of ways to reduce

climate risks, or analysis of the risks themselves, is not included. The only activities dealing directly with climate risks in the activities matrix attached to the Tenth Plan are a couple of emergency management items in the urban development section (construction of emergency shelters and provision of housing for disaster-affected families). The overall Medium-Term Expenditure Framework (MTEF) does not discuss climate risks either. Ideally, climate risk management would be mainstreamed in many of the sectoral activities in the MTEF and in the activities matrix (such as hydropower development and agriculture projects). However, effective mainstreaming requires explicit attention at the policy level. Such attention is not reflected in the Tenth Plan (Agarwala *et. al.,* 2003).

It is also found that the sectoral MTEF papers for some of Nepal's vulnerable sectors underlines the impression that climate change is ignored and climate risks in general tend to be neglected in the country's development policy. For instance, the MTEF paper for the power sector does not recognize risks to hydropower plants due to the variability in runoff, floods (including GLOFS), and sedimentation. The MTEF paper for the health sector contains targets for vector-borne disease control, emergency preparedness and disaster management, but does not explicitly discuss natural hazards and climate risks. The road sector does not discuss flood and landslide risks, nor does the sector for water supply and sanitation discuss variability in rainfall, which may strongly affect the success of measures in this sector. (Agarwala *et. al.,* 2003).

The MTEF paper for the agricultural sector pays some attention to climate-related risks. For instance, it mentions the criticality of the monsoon season for the sector. Moreover, a review of previous activities showed that outreach had been ineffective, mainly because it had been characterized by a top-down approach and a lack of orientation on small farmers' problems, namely "rain-fed and poor soils". Implicitly, this diagnosis identifies climate conditions as one of the challenges that poor farmers face, and that are currently lacking attention. The proposed solution, "major research funds to be used in need-based adaptive research" seems unfocused, possibly a reflection of a lack of sufficient information on the importance of climate risks in the agriculture sector, and of a lack of awareness of options to reduce such risks. The document also proposes various other investments to improve the functioning of the agricultural sector that are likely to reduce vulnerability to climate-related risks.

3.1.2 Climate Concerns in Environment Focused Plans and Reports

Nepal is a party in several multilateral environmental agreements including the three Rio Conventions: the Framework Convention on Climate Change (UNFCCC), the Convention to Combat Desertification (UNCCD), and the Convention on Biodiversity (UNCBD). Nepal's most recent national report to the UNCCD was prepared for the Fourth Conference of the Parties (COP-4) in 2000. The report pointed out the need for integration of responses to the UNFCCC and UNCCD, but few concrete stepswere outlined. However, a number of desertification specific responses outlined in the report, for example, integrated watershed management, and community-based soil and water management are in fact no-regrets options (or low regrets options) measures for adaptation to climate risks.

Nepal's Country Profile for the World Summit on Sustainable Development (WSSD) (2002) discusses climate change only in the context of mitigation of greenhouse gas emissions. The section on sustainable mountain development pays attention to indigenous systems of human adaptation to challenging geographic and climatic circumstances in mountainous areas as a part of development and not as adaptation to climate change. Furthermore, many elements of the proposed sustainable development policies (designed for current climatic circumstances) would also be no-regrets measures for adaptation to climate change.

Nepal's National Assessment Report for the WSSD (2002) recognises the links between climatic circumstances and land degradation, erosion and landslides. It also recognizes the increase in landslide risks due to the effects of paddy cultivation and livestock grazing in the hills and mountains. However, the fact that climate change might increase those risks is not discussed, and adaptation to climate change is not mentioned anywhere.

Nepal also has a National Strategy for Sustainable Development (NSSD) under the name of the Sustainable Development Agenda for Nepal (SDAN). The SDAN lists Nepal's continuing vulnerability to climate change, natural disasters and environmental degradation among the constraints facing Nepal's Sustainable Development. It also contains a separate section on climate change, which lists the

potentially serious consequences for infrastructure, agriculture, drinking water, irrigation, hydropower, and biodiversity, and mentions the risk of GLOFs. Climate change is not mentioned as a risk in the context of other sustainable development challenges, except in the case of biodiversity and natural disasters (increasing risk of GLOFs). Broader climate risks, including natural hazards such as floods and droughts, feature prominently, and concrete disaster mitigation measures are proposed (including the establishment of a national disaster preparedness and management agency, the creation of village-level early warning systems for floods, landslides or earthquakes, the building of decentralized emergency response capacity, the enforcing of design standards for buildings and infrastructure that take into account site-specific risks, the investment in better weather and earthquake prediction systems, and, specifically for GLOFS, the monitoring of lakes and preparation of siphon materials) which is consistent with the need to address the critical climate impacts.

The Sustainable Development Agenda for Nepal recognizes the need to build capacity to minimize the adverse impacts of climate change. The report identifies a number of shortcomings in Nepal's approach to climate change: the delay of the National Communication to the UNFCCC, the lack of attention in national policy documents, the very low awareness among policy makers and the general public, and the low institutional capacity, also in international negotiations. In the context of climate change mitigation, the report points out that while the potential for Clean Development Mechanism (CDM) projects seems limited, many programs on alternative energy are being implemented without explicit linkage to climate change issues.

3.1.3 Climate Concerns in Donor Activities

The limited explicit attention to climate risks that is apparent in Nepal's own development strategies is also reflected in many of the major donors' strategies for the country, as can be seen in documents from multilateral agencies like the World Bank, the UNDP and the International Fund for Agricultural Development (IFAD), as well as bilateral donors such as the Department for International Development (DFID) and the US Agency for International Development (USAID). All of these strategies contain measures that will reduce Nepal's vulnerability in various, often indirect, ways.

However, explicit attention to climate risks is lacking, and some opportunities for vulnerability reduction may well be missed (Agarwala *et. al.,* 2003).

Several of the strategy documents, however, do implicitly acknowledge the potentially large impacts of climatic factors on the success or failure of development investments. For example, the World Bank's Economic Update for the 2002 Nepal Development Forum mentions that good rainfall has been one of the factors that contributed to the higher growth in the agricultural sector in recent years, putting climate on a par with increased use of fertilizer, private sector entry in the supply of inputs, better educated farmers, crop diversification, growth of agricultural credit, and improved infrastructure and irrigation. In addition, a relatively poor performance in agriculture is expected in the current year "following the untimely rainfall in September 2002". Nevertheless, when discussing priorities for the agricultural sector, the need to improve the resilience of the agriculture sector against adverse climatic conditions is missing. A similar pattern arises in the Asian Development Bank's (ADB) Country Assistance Plan. USAID's Nepal Annual Report evaluates past performance and updates priorities for the coming years. The agency concentrates on hydropower development, health, and governance of natural resources. While these sectors are clearly sensitive to climate, the report contains no references to climate risks. DFID's Country Strategy Paper for Nepal (1998) presents a similar picture as the World Bank and ADB strategies: it suggests ample components that may well contribute to reducing Nepal's vulnerability, but shows no explicit attention to climate risks.

UNDP's Second Country Cooperation Framework (CCF 2002-2006) focuses on poverty reduction and sustainable development, but does not discuss the impacts of climate-related risks in these areas. However, a few crosscutting themes, including disaster mitigation, will be addressed in all projects and programmes of the CCF. This would mean that climate risk reduction ought to be mainstreamed in UNDP's activities in the coming years. No specific examples of such mainstreaming are offered in the CCF.

The IFAD Country Strategic Opportunities Paper (CSOP) addresses several aspects of vulnerability in the hill and mountain areas of

Nepal, but pays little explicit attention to current climate-related risks, and entirely neglects climate change. However, it does bring up an interesting dimension of climate-related vulnerability in Nepal, particularly in relation to the hill and mountain areas. These areas are very poor, remote, and lack physical and social infrastructure. They became even more isolated and marginalized when they missed the "green revolution" because new agricultural technologies that helped to spark agricultural growth in other parts of the country were not suited for rain-fed agriculture in difficult mountain terrains and climates. In combination, these factors have contributed to a downward spiral of poverty and lack of empowerment, leading to a lack of benefits from investments at the national level, and thus to further poverty. Climate change could intensify such inequalities (but this is not discussed in the CSOP).

3.2 National Adaptation Programme of Action (NAPA)

The preparation of the National Adaptation Programme of Action (NAPA) is the first official initiative for mainstreaming adaptation to national policies and actions for addressing adverse impacts of climate change and reduce vulnerability to climate stimuli including extreme events. It will be a document of project portfolio giving emphasis on the most urgent and immediate needs of the country and the implementation of these projects and activities will reduce both the vulnerability and the cost that otherwise will occur if addressed later.

Nepal has prepared the project document to initiate the National Adaptation Program of Action (NAPA) with participation from a multi-disciplinary team, coordinated by MOPE. However, the activities are yet to be started though the development of the actual NAPA is expected to begin shortly. Two committees will oversee technical and administrative issues, while the National Study Teams (NSTs) will carry out sector-related work. Reports will be circulated regularly to relevant institutions, and public consultations will be held to gather input from key stakeholders.

- Steering Committee (SC)—The SC will "provide policy-related oversight for the implementation of the project and ensure the effective participation of relevant sectors of government and the societies." The Environment Division Chief of MOPE will

chair the committee as secretary. The SC will include senior members of national institutions responsible for environmental policy.

- Executive Committee (EC)—The EC, also chaired by the Environment Division Chief of MOPE, will "serve as the technical body for the project and will be composed of leaders of the National Study Teams (NSTs) and other relevant technical experts from various ministries, private and public sector organizations, universities and research institutions."

- National Study Teams (NST)—The multi-disciplinary nature of this study area requires teams composed of experts from a variety of government agencies, research institutions, and NGOs.

3.2.1 Institutions Involved

The NAPA activity will be coordinated by the Ministry of Population and Environment and will involve the Environment Protection Council (EPC) that includes high-level representation from other major ministries, scientific institutes and academia, and the private sector. It has also been mentioned that NAPA will involve the following ministries, departments and other organisations.

a. Ministry of Water Resources
b. National Planning Commission
c. Ministry of Science and Technology
d. Alternative Energy Promotion Center
e. Ministry of Agriculture and Cooperatives
f. Ministry of Finance
g. Department of Hydrology and Meteorology
h. Ministry of Forest and Soil Conservation
i. Ministry of Industry
J. Water and Energy Commission Secretariat
k. NGOs, industrial associations, etc.

3.2.2 Priority Sectors

Nepal is closely linking climate change adaptation to poverty alleviation, in addition to maximizing synergies with other environmental concerns such as land degradation, biodiversity, and disaster reduction. The draft national communication has identified the Forestry, Crops, Water Resources, and Health as priority sectors, which will be incorporated in NAPA.

3.2.3 Capacity Needs

The NAPA process document identified that Nepal need capacity to a) translate provisions of conventions into concrete national activities, policies, and laws, b) skills in taxonomy, climate science, environmental economics and environmental law, c) negotiating skills for environmental agreements, and d) awareness among the general public, policymakers, and media regarding UNFCCC and climate change implications for Nepal.

4 Concluding Remarks

Nepal is facing a number of challenges for achieving social, economic and environmental development set out in the national development plan. Low economic strength, inadequate infrastructure, low level of social development, lack of institutional capacity, and higher dependency on the natural resource base makes the country vulnerable to change in climatic system including variability and extreme events. Tenth Development Plan sets poverty alleviation as its overarching objective and target is to reduce poverty level to 30% by the year 2007 from the existing 38%. Even full achievement of the target will not able meet target of millennium development goal.

It is evident from different studies that adverse effects of climate stimuli including variability and extreme events will put addition stress on overall development. Anticipated changes in the water sector and flow regime found to be most critical as other sectors will be impacted significantly. Retreating glacier and volume of glacier lake outburst related hazards is growing and presumably it will increase under the warmer climate. Key water related disasters would be flood, drought, erosion and landslide that may occur with greater frequency or intensity in the future. Generation of hydroelectricity would be another area of great concern for Nepal unless proper measures take into account in design and implementation of hydropower projects.

It is also noticed that climate change is likely to have serious consequences in agriculture as most of the population is directly dependent on a few crops, such as rice, maize, and wheat. Higher temperatures, increased evapo-transpiration and decreased winter precipitation may bring about more droughts in Nepal. Decreased precipitation from November to April would impact the winter and spring crops. Rice yields would fall in the Western and Far Western Regions where a greater population of the poor live, threatening food security. Overall it is found that the population living in the Terai plain and hilly areas are more vulnerable than the population in other areas.

A number of policy documents have identified existing challenges in relation to broader environment and natural resource management, and have also recognized the impact of weather events and natural disasters. However, the government and donor agencies' they have not explicitly recognised climate change in their development plans and

strategies. Several strategies mention the mitigation potential of Nepal's hydropower and forestry sector, but no win-win options for combined adaptation and mitigation (for instance by forestation) are discussed. An even more important point is that several donors and the government are in fact actively engaged in projects to reduce the risk of GLOFs and up scaling of such activities are necessary to address the future threats. Ignorance of potential climate induce impacts will limit or slow down the achievement of overall development.

A number of win-win options and measures have been identified in the tenth plan. A couple of emergency management items in the urban development section (construction of emergency shelters and provision of housing for disaster-affected families) have been proposed in the tenth plan and these are no-regret options in terms of addressing adverse impacts of climate change. Disaster preparedness for the rural households and the agricultural sector and improved management of agriculture is necessary and important in order to reduce the vulnerability to climate change and extreme events.

The country has experiences in forest resource management with community participation. For example, leasehold forest managed through users' groups. In 1993, a total of 270 hectares of state-managed forest was handed over to user groups for leasehold forest and it was increased to over 1,100 hectares in 1996. Sustainable management and development of forests through the involvement of communities as forest user groups is very important with regard to forest development in the country. In 1999, the government handed over a total of about 0.606 million hectares of state-owned forest to over 8,300 community forestry user groups for development, conservation, management, and sustainable use of the forests. A total of 0.929 million people is directly benefited by being members of user groups.

The National Adaptation Programme of Action (NAPA) appears to be the first attempt to bring different stakeholders, including the government and the civil society, together. However, one of the key stakeholders, the donors, who will play vital role (about 45 percent of the government expenditure is provided by donors) in the implementation of the projects and activities that will be identified in the NAPA document, is left out. The involvement of donors and development agencies from the very beginning along with other sectoral agencies, particularly planning and finance, will help mainstreaming adaptation to climate change.

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About CLACC

Capacity strengthening in the Least Developed Countries (LDCs) for Adaptation to Climate Change (CLACC) is a multi country project being implemented by the International Institute for Environment and Development (IIED) in associating with four regional and International Networking Group (RING) partners i.e. the Bangladesh Centre for Advanced Studies (BCAS), the African Centre for Technology Studies (ACTS) in Kenya, the Environmental Development Action in the Third World (ENDA) in Senegal and the Zimbabwe Environmental Research Organization (ZERO) in Zimbabwe with financial support from a number of development partners.

The aims of the project is to support LDCs in their efforts to adapt to the impacts of climate change through long-term capacity strengthening activities with governments as well as civil society. The main objectives of the project are to a) strengthen the capacity of civil society in LDCs to adapt to climate change and enhance adaptive capacity among the most vulnerable groups, b) establish an information and knowledge sharing system to help countries to deal with the adverse impacts of climate change, and c) integrate adaptation to climate change into the work of key non-government institutions, and help mainstreaming adaptation in the government policy-making and programme development process.