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## Human Development Report **2007/2008**

**Fighting climate change:  
Human solidarity in a divided world**

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### **Country Case Study – Nepal**

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# Human Development Report 2007

## Climate change and human development – risk and vulnerability in a warming world

### Country Case Study-Nepal

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## **BACKGROUND**

Climate refers to the average weather and represents the state of the climate system over a given time period. Climate changes over time may be due to natural variability or as a result of human induced increases of greenhouse gases in the atmospheres and is reflected in the variation of the mean state of weather variables including temperature, precipitation and wind (Orindi and Eriksen, 2005).

The impact of global warming is already being felt by the most vulnerable-the world's poorest people and countries and its impact is severe on Nepal because of the geographical and climatic conditions, high dependence on natural resources and lack of resources to cope with the changing climate. Developed countries are mainly responsible for global warming and they need to take concrete steps and actions to reduce their greenhouse gas emissions. However, as climate change will effect everybody, the entire global community needs to work together to address this major problem (CEN, 2003). A series of summits and conferences have stressed the urgent need to combat the threats arising from the anthropogenic emissions of GHGs in the atmosphere. UNFCCC is one of them. It has recognized pertinent issues and put emphasis on the capacity building and technology transfer of environmental friendly technologies in developing countries.

Nepal has a negligible share in the global emission. According to the National Communication Report recently prepared by HMG, net emission of CO<sub>2</sub> was about 9.747 tonnes and the net emission of methane was estimated to be 0.948 tones in 1994. In addition, annual emission of carbon monoxide (CO) rose slightly from 0.638 million tons/year (mt/yr) in 1990 to 0.693 mt/yr in 1996 with the exception of 2.14 mt/yr in 1994. This fluctuated for sulphur dioxide (SO<sub>2</sub>) with 0.11 mt/yr in 1994 and 0.028 mt/yr in 1996. A similar situation has been observed for nitrogen oxides (NO<sub>x</sub>) and TSPs (CBS 1998). Based on these estimates, there is no change in the amount of carbon (only 292 tons/yr) released by deforestation activities. However, carbon released from fuel burning increased by over 60 per cent (from 4.7 to 7.4 mt/yr) between 1985 and 1998. Estimates also indicate that while the total emission of carbon dioxide (CO<sub>2</sub>) was only 0.2 mt in 1990, it will reach 2.07 mt by 2030. This indicates that the per capita emission of 42.6 kg of CO<sub>2</sub> in 1990 was from the use of petroleum products such as kerosene and diesel and this will reach 220.6 kg by 2030 (CSMT 1996 in MOPE, 2000). It is also estimated that Nepal consumes about 12.5 mt/yr of fuelwood, which could roughly emit 5 mt of carbon into the atmosphere. Furthermore, Nepal uses about 30 tons of chlorofluorocarbons (CFCs) and 23 tons of hydro-chlorofluorocarbon (HCF<sub>22</sub>) in refrigerators, and CFC consumption is increasing at the rate of 10 percent in dairy and commercial refrigeration.

Although, Nepal's total GHG emission share is negligible compared to the global scenario, Nepal has already encountered some of the negative effects of global climate change. The snow melting and increase in the size of glacier lakes in the Himalayan region is one of the major concerns. It is further supported by the fact that no lake was noticed in Barun area in the 1964 topographic survey. A small glacier lake of only 0.0245 square kilometer (km<sup>2</sup>) was observed in 1995 and but the size had increased to 0.78 km<sup>2</sup> by the year 1997. Expansion in the size of Tsho Rolpa Glacier Lake is also obvious. A glacier lake assessment study clearly indicated that its size had increased from only 0.23 km<sup>2</sup> in 1957-1959 to 1.02 km<sup>2</sup> in 1979 and to 1.65 km<sup>2</sup> in 1997 (MoPE).

Nepal has a considerable stake in climate change activities. The first is due to its own vulnerable situation and the second is due to international donor driven interests. About 85.8 percent of the total population reside in rural areas of Nepal and meet their energy demand from biomass combustion, particularly firewood, while about 15 percent of the total population living in urban areas is exposed to different levels of

concentration of gases, including greenhouse gases (GHGs). The Himalayas constitute a threatened ecosystem in the world. Himalayas in Nepal are geologically young and fragile and are vulnerable to even insignificant changes in the climatic system. This system is threatened through anthropogenic activities such as farming practices and natural resource consumption patterns.

## Objectives

Donor agencies must assess and reduce the climate change risks to their investment portfolios, while national governments in developing countries must understand the vulnerabilities they face and take steps to enhance the adaptive capacities of the most exposed populations and sectors. Considerable attention must also be placed on the role of local communities and assessing and addressing vulnerability to climate change and building linkages between local, national and international scales will be vital. Increased climate impacts are inevitable, as are adaptive responses. Ultimately, there must be a move away from 'adaptation projects' and debates over their costs, and instead assess what needs to be done to achieve climate-resilient, pro-poor development. Therefore the objective of the report is to draw on case study material to critically assess international and national adaptation mechanisms and their linkages with vulnerabilities faced at local scales in order to generate an agenda to improve adaptive capacity and resilience at multiple scales.

## METHODOLOGY

**Desk review:** Relevant literature and information available on Climate Change, Adaptation and Mitigations were reviewed in order to gather the information relevant to this report and find the gaps in the literature. The literature reviewed was both local and national level documents including the initial national communication on climate change and plan for combating desertification in order to identify how efforts to achieve climate change adaptation can be mainstreamed in to development policies.

Besides the literature, different Policies related to climate change of Nepal were also reviewed in order to find out the focus and emphasis of provision made on climate change. The different policies included: UNFCCC policy on CBD, UNCCD policy on Desertification, UNFCCC policy on Climate change, Poverty Reduction Strategy Paper (PRSP), Human Development Report, Environmental Policy and other Sectoral Policies.

**Consultation with key stakeholders:** Based on the review of literature, a list of organizations involved in climate change work were identified and the organizations were divided into two categories i.e. organization that are directly involved or implementing the climate change related projects and organization who are supporting the implementation of climate change works. After finalizing the checklist, each of the organizations listed were visited for the information collection purpose. An interaction was also organized with the UNFCCC focal person and officials responsible for implementing climate change activities in the National context.

## COUNTRY SCENARIO

**Geography:** Nepal is endowed with rich natural and cultural diversity and is situated in the southern Himalayan flank, with a total area of 147,181 km<sup>2</sup>. The average North-South width is about 193 km and East-West length averages to 885 km. The country is landlocked and lies between India in the east, west and south and the People's Republic of China in the north at 26° 22' to 30° 27' North latitude and from 80° 04' to 88 ° 12' East longitudes with an altitudinal range from 60m in the south to 8,848m in the north (MOPE, 2004). Geographically, Nepal represents a transitional mountain area with over three quarters of the land covered by rugged hills and mountains. The geological formations correspond to the physiographic zones and most parts of the country are geologically weak and fragile. The Siwaliks and Middle Mountains are ecologically threatened and geologically vulnerable.

Nepal is broadly divided into three ecological regions: the Terai (plain area) in the south, the Hills in the middle and the Mountains in the north covering 23, 42 and 35 percent of the total area respectively. Terai is a low-lying plain, highly vulnerable to floods during the monsoon. Similarly the mountain and hills due to its sloppy and fragile landscape is vulnerable to extreme climatic events.

**Climate:** Nepal has a wide range of climate from the tropics to the alpine regions. The remarkable differences in climatic conditions are primarily related to the enormous range of elevation within a short north south distance. There are four seasons in Nepal namely Spring, Autumn, Summer and Winter. The national mean temperature is around 15°C, and 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 Celcius per year. The maximum temperature of the year occurs in May or early June and starts decreasing rapidly from October and reaches the minimum of the year in December or January. The average rainfall of the country is 1,500mm. Nepal receives abundant rainfall, but the distribution throughout the year is of great concern with regards to 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. The annual mean precipitation is around 1800 mm in Nepal with 80 percent of it occurring during the monsoon season (June to September).

**Socio-economic condition:** - By religion Nepal is composed of 80.62 percent Hindu and the remainder is made up of Buddhists (10.70 %), Muslims (4.20%), Kirat (3.60%), Christian (0.45 %) and others (0.40%) (CBS, 2001). The census of 2001 has listed more than 100 caste/ethnic groups as inhabitants of Nepal having their own culture and languages. Almost half of the population lives in the Terai region, where the land is more suitable for cultivation. 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 labor, and a landlocked location. Nepal's GDP is US\$5.5 billion; an annual average growth rate of 4.9 percent and per capita income is US\$250, which is among the lowest in the world.

**Population:** Nepal has a population of 23 million with a growth rate of 2.24 percent (NPC, 2001). However, the population is overwhelmingly concentrated in rural areas, with only 12 percent living in urban areas (World Bank, 2002). Consequently, rural population density is relatively high at 686 people per square kilometer, a figure that exceeds that for most low income countries (World Bank, 2002). Nepal has one of the highest population densities in the world with respect to cultivable land (MOPE, 2000). Population projected for the year 2006 is 25.8 million. Life expectancy at birth is 63.3 years, the lowest in South Asia;

infant mortality per 1,000 live births is 64.4, the highest in South Asia; and illiteracy among the population above the age of 15 is 62 percent, (World Bank, 1999, CBS 2006).

**Economy:** The agriculture sector employs most of the labor force which was at 82 percent in 2000. Despite engaging a majority of the population, agriculture is primarily a subsistence activity and contributes only 38 percent to GDP, compared to industry at 23 percent, and services at 39 percent (NAPA Case Study, 2003). The preliminary estimates of per capita GDP and per capita GNP in terms of US dollar are 315 and 322 at a current price respectively for the year 2005/2006. 31 percent of the population are below the absolute poverty line. Nepal's economic growth of the country has not improved substantially over time to overtake population growth. Nepal's economy is overwhelmingly dependent on agriculture. Approximately 40 percent of the country's GDP came from agriculture in 2000, down from 52 percent in 1990 (MOF, 2002). Nepal is a major tourist destination; a significant fraction of foreign earned income is dependent on the country's natural resources. Tourism receipts in 2000 mounted to 15 percent of exports. A heavy reliance on tourism and agriculture makes Nepal's economy very sensitive to climate variability (World Bank, 2002).

With a Human Resource Development Index of 0.332, Nepal ranks 151 among 174 countries (HRD, 2001). Nepal is one of the poorest countries in the world, with 82.5 percent of the population living below the international poverty line of \$2 per day (World Bank, 2003). A Gini coefficient of 0.37 indicates that income distribution is somewhat uneven. In fact, some 38 percent of the population survives on less than US\$1 per day. However, Nepal has considerable scope for accelerating economic growth by exploiting its potential in hydropower and tourism; these are the areas of recent foreign investment interest (World Bank, 2002).

**Forest and Land use:** About 80 percent of the population of Nepal depends on the forests for daily fuel wood supply and 42 percent on the fodder for livestock as these are extracted from the forest (WECS, 1997). Therefore, forest stands as one of the most important natural resources to meet the basic needs of firewood, fodder and timber of the people. The land resource map of the country has revealed that cultivated land covers about 20 percent of the total land, forest 29 percent, grassland covers 12 percent, shrub lands 11 percent, and other categories like rocks, snow lands and settlements make up the rest. Of the total forestland, 35 percent is in the hills and one-third in the mountain region (UNEP, 2001).

**Bio-diversity:** Nepal is also rich in fascinating biological diversity. Nepal occupies only 0.03 percent of the total surface of the earth (MoPE, 2001) and covers 0.1 percent of the world's land area but has high representation of biotic diversity. It claims 9.3 percent of bird, 4.5 percent of mammal, 2 percent of reptiles, 6 percent of butterfly, 1.0 percent of fish and over 2.0 percent of the flowering plant species of the world. This richness of species can be attributed to the immense physical and climatic variation of the land. The immense bio-climatic diversity in Nepal supports more than 35 forest types (Stainton, 1972). They are home to 5833 species of flowering plants, including about 248 species of endemic plant and 700 species of medicinal plants. Nepal's landmass is also home to 185 species of mammals, 847 species of birds, 645 species of butterflies, 170 species of fish and other animals (MoPE, 2001).

**Water resources:** Nepal is one of the richest countries in water resources. The monsoon contributes significantly in water regime of the country. As a result, several sources of water in the form of glaciers, snow pack, groundwater, and river networks exist in Nepal. The country has about 6000 rivers and streams including 3 major river basins: Sapta Kosi in the east, Karnali in the west and Sapta Gandaki in the central

part the country (Upadhyay, 2000). The annual run-off from the total drained areas is estimated to be 202 billion m<sup>3</sup>. The contribution from the Nepalese territory accounts to an annual run-off of 170 billion m<sup>3</sup>. About 4063 sq km is estimated to be covered by surface water, of which 97.3 percent is under the large rivers followed by natural lakes (1.2 %), ponds (1.2 %) and reservoirs (0.3 %) (HMG, 1992). The area under snow and ice is 17,920 km<sup>2</sup>, which represents about 13 percent of the country's total area (WECS, 1988). Nepal's Terai belt has rechargeable ground water potential, which occurs in both artesian and non-artesian aquifers (WECS, 2002). The theoretical potential on the basis of average flow is estimated to be 83000 MW electricity (Shrestha, 1968), out of which 44,600 MW has been assessed to be technically feasible, while 42,130 MW (50.6 Percent) could be economically harnessed (Sharma and Adhikari, 1990).

**Mineral Resources:** In the past, Nepal was known as a mineral producing country and the metals such as iron and copper were exported to Tibet. But on the present day perspectives, most of existing mineral deposits are known to be small and unprofitable. The total reserve of natural gas from whole of the prospective area is expected to be around 300 million m<sup>3</sup>. Exploration has revealed that about 15.3 million tons of limestone and 10 million tons of proved cement grade limestone are known to exist in average down to a depth of 60 m in Nepal. High-grade limestone reserve of 70 million tons is also known to occur in Nepal. Further, 64.58 million tons of cement grade limestone are the expected reserves waiting to be exploited in the near future. As for the coal, apart from the low quality lignite deposits, commercial coal deposits supply about 25 Percent of the total demand of coal in Nepal (Sharma and Thapa, 2000).

## CLIMATE CHANGE RISK AND VULNERABILITY

### Climate change Scenario

Evidence presented by the IPCC reveals that the world's climate is changing. Evidence strongly suggests that humans have exerted and continue to exert an influence on the world's climate. The IPCC asserts that the warming of the last 100 years was unusual and unlikely. As humans have increased their levels of production and consumption, greenhouse gas emissions have also increased. Since 1750 at the time of the industrial revolution, CO<sub>2</sub> has increased by 31 percent, methane by 151 percent and nitrous oxide by 17 percent.

In the case of Nepal, it was found that temperature in Nepal is increasing at a high rate. The warming seems to be consistent and continuous after the mid 1970s. The average warming in annual temperature between 1977 and 1994 was 0.06<sup>o</sup> c/yr (Shrestha et. al, 1999). The warming is found to be more pronounced in the high altitude regions of Nepal such as the middle mountain and the high Himalaya, while the warming is significantly lower or even lacking in the terai and siwalik regions. Further, warming in the winter is more pronounced compared to other seasons. According to one recent study, Nepal's temperature is rising by about 0.41 degrees Celsius per decade. Another study conducted in the vicinity of Tsho Rolpa Glacial Lake in Dolakha District suggests that mean temperature is increasing annually by 0.019 degrees Celsius with an increase in average summer temperature of 0.044 degrees Celsius. This is causing rainfall to increase by 13mm per year, while the number of rainy days is decreasing by 0.8 days per year. Consequently, river flow is increasing at 1.48m<sup>3</sup>/s per year, which is about 1.5 times higher than increased precipitation. High increases in summer river flow provide further evidence that high summer temperatures are leading to fast glacial melt/retreat (Dahal, 2006).

Similar to temperature, precipitation in Nepal is found to be influenced by or correlated to several large scale climatological phenomena including El Nino/Southern Oscillation, regional scale land and sea surface temperature changes and extreme events such as volcanic eruptions. Mean annual precipitation is increasing, as is the occurrence of intense rainfall. This causes more erosion of soils and riverbeds and banks, as well as sedimentation on fertile land.

Weather-related extreme events like excessive rainfall, longer drought periods, landslides and floods are increasing both in terms of magnitude and frequency. More floods and glacial lake outbursts are expected to destroy irrigation and water supply systems, roads, bridges, settlements and productive land. Flood-related deaths will increase. Land degradation will reduce crop productivity and put more pressure on remaining fertile land. In the dry season, increased evaporation will lead to water scarcity. Soil moisture deficits, droughts, fire and possible pest outbreaks will decrease crop yields. It is perceived that climate change will have major impacts on ecosystems, land and water resources, health, and major economic sectors such as agriculture in days to come.

Communities of different parts of Nepal have already begun experiencing unusual changes in weather patterns. Some of them are happy with these changes; for example, farmers of Mustang and Manang districts have noticed improved apple sizes in recent years. But others face hardship; for example, water leakage into traditional houses has increased, which people feel is due to new precipitation patterns (Dahal, 2005).

#### **Case 1: Local perceptions changes: case of Manag District**

Many of the highland residents of Manang in the Annapurna Range of the Himalayas have observed heavy monsoon rains in recent years. Previously, monsoon rains used to be of lower intensities and amounts, and heavy monsoon rains only occurred at lower altitudes. Intense rainfall has affected traditionally-built flat-roofed houses made of mud and stone. Roof leakage and wall erosion problems are a major concern for low-income families who cannot afford to regularly repair their houses.

Some farmers in Mustang, the neighboring district to Manang, say that the changed climate has significantly impacted their lifestyles. They are confident that the climate has changed, not because they know much about global warming or reports of rapidly receding Himalayan glaciers, but because of their long experience with the realities of the local environment. For most of them the impact is positive. Farmers are growing new vegetables such as cauliflower, cabbage, chili, tomato and cucumber, which used to need greenhouses to survive. Local fruits have better sizes and tastes. New plants that only used to grow at lower altitudes can now be found. Many note the fact that their Himalayan district is greener than it was a few decades ago. Local residents say this is because of the changing climate rather than technological inputs or improved seed varieties.

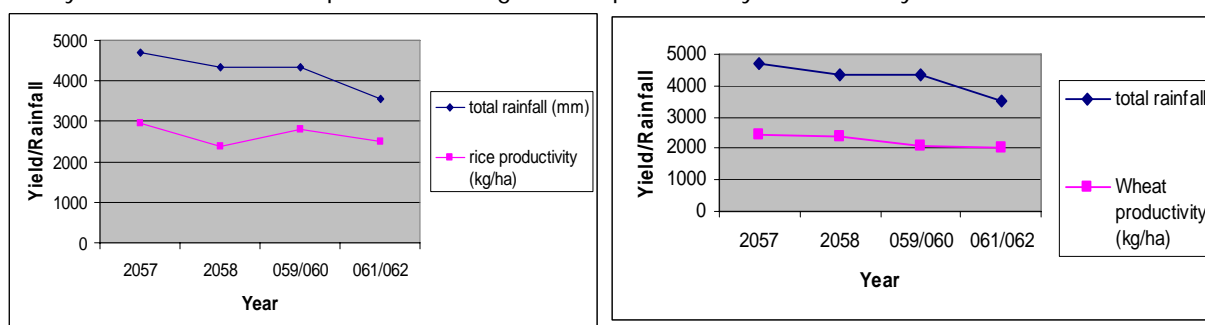
Although some farmers in some parts of Nepal might be benefiting in the short run due to increases in temperature there are farmers in other parts of the country who are really worried about the changing climatic scenario. The delay in monsoon season experienced recently in last 3 years in Nepal has changed the cropping pattern and crop maturity period. This has pushed the planting and harvesting season a month back and in turn affected the rotational cropping system in Nepal. The delay in monsoon season has made thousands of hectares of farm land fallow and the production has gone down due to lack of water and

delayed rainfall. Farmers have experienced that the intensity of rainfall has gone down and the rivers and springs are dried and with little amount of water.

### Case 2: Intensity of Slash and Burn has increased

Farmers of Abukhaireni VDC in Tanahun district of Nepal have rapidly increased their slash and burn area this year. These farmers used to do their paddy cultivation in rainfed land during the monsoon season. But due to late monsoon and decrease in rainfall, these farmers say that they are forced to slash and burn the nearby forest and cultivate in the land. According to them, they have no choice to cope up with the potential food shortages if they only depend on the rainfed land. (Source: LI-BIRD, 2006)

The analysis of the rainfall, temperature and agriculture production yield in last 3 years in Kaski district of



Nepal clearly shows that correlation of rainfall and production yield. It was revealed from the analysis that the rice and wheat production has gone down in the 3 years due to decreases in annual mean rainfall while the production of maize has increased a bit. Due to heavy monsoon from Bay of Bengal, various parts of Nepal experienced drastic decreases in temperature and snow fall. The capital city of Nepal, Kathmandu, experienced snowfall after 62 years. Similarly some district headquarters of western region observed snowfall for the first time in history. The unexpected snowfall has taken life of 4 people across the country. Majority of the poor people have suffered the most from this recent weather extreme.

### Who are most vulnerable?

In both developing and developed countries, the impact of climate change can be much greater for indigenous communities who rely most directly on their immediate environments for subsistence and livelihood often living in the more remote and ecologically fragile zone (UNFCCC, 2004). Hence some groups are said to be more vulnerable than others. Ecological changes noticed in the high Himalayas indicate that global warming will have a serious impact on the lives and livelihoods of local communities. World Bank, 2003 also mentioned that all countries are vulnerable to climate change but the poorest countries and the poorest people within them are most vulnerable.

In Nepal the poor, marginalized and disadvantaged groups of people are more vulnerable to the climate change impacts. In the context of Nepal, poor means those people who are landless, who depend entirely on nature and in particular natural resources, who are economically backward, isolated i.e. in terms of trade, weak infrastructure, and lack of access to technology and information and armed conflict. These factors will make it more difficult for these people to cope with the agricultural consequences of climate change. It is also mentioned by different studies and reports related to climate change. The national communication report has also identified that the poor people are most vulnerable due to climate change.

The livelihoods of most poor people, especially in rural areas, depend on natural resources and climate sensitive sectors such as agriculture, forestry and fisheries. They have few options for diversifying livelihoods away from these sensitive sectors and reducing vulnerability. Poor people often do not have enough assets to sustain or rebuild livelihoods after the impact of hazards, because of low financial resources, poor health, lack of clean water and sanitation, weak physical infrastructure and remoteness from government services. Lack of access and ability to use technology reduces their speed of recovery and options for livelihood strategies. Organization of protection for people in developing countries can be inadequate.

A study conducted by Nepal Trust for Nature Conservation (NTNC) found that Nawalparasi and Kapilvastu in the western region and Mahottari in the central region are highly flood prone districts which have received no or very limited government or external support for disaster preparedness. Flash floods and a series of dams along the Indo-Nepal border are the most common causes for flooding. Deaths often occur, as well as extensive devastation: houses and vast land masses are washed away, river banks are breached, and peoples' assets such as animals, standing crops, food stocks and non-food items are damaged or lost due to this. Vulnerability in these districts has been further exacerbated by conflict in recent years.

Similarly, the people living in fragile mountain slopes and in particular hilly regions of Nepal are experiencing the impact of drought, landslides, erosion and loss of important biodiversity. The extremity in the rainfall is making it more difficult for these people to cope. The majority of the farmers depend on the monsoon rain during the crop cultivation and due to the rainfed land the production is entirely dependent on the natural springs and rainfall. Similarly the extreme rainfall and water downpour causes landslides and erosion and destroys farmers property and even takes their life. The river cuts and flooding also washes houses and lands of hilly people.

### **Vulnerable sector**

The most vulnerable ecological and socio-economic systems are those with the greatest sensitivity to climate change and the least ability to adapt. 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. Nepal's major natural resources, biodiversity and water, are at the forefront of climate vulnerability (Raut, 2006). Climate change impacts in agriculture, forestry/biodiversity, and health would have serious consequences for Nepal and people's livelihoods. The national communication report has also identified the highest priority sectors are forestry, crops, water resources and health. Nepal's low level of development and complex topography leaves it quite vulnerable to climate change. In the context of Nepal different studies identify the following sectors are more vulnerable due to climate change:

*Water resources*- The vast water resource potential of Nepal has considerable importance in the economic development of the country. However, Nepalese river basins spread over such diverse and extreme geographical and climatic condition that the potential benefits of water are accompanied by risks. Besides, Climate Change could add a new dimension to water management: the availability of only 26 km<sup>3</sup> water out of total water (202 km<sup>3</sup>) in dry season shows that water scarcity is imminent in Nepal unless water resources are properly managed. In fact, water demand in Nepal is estimated to increase by seven-fold within the next 25 years. With population growth rate exceeding two percent per year and with increasing

standard of living and increasing industrial development, it is certain that water crisis in the coming years will grow principally in the dry seasons. Thus, water stress and water scarcity may worsen in future. Greater unreliability of dry season flows, in particular, poses potentially serious risks to water supplies in the lean season. The monthly variability of runoff is quite high. Hydroelectric plants are highly dependent on predictable runoff patterns. Therefore, increased climate variability, which can affect frequency and intensity of flooding and droughts, could affect Nepal severely.

The changes in temperature and precipitation will alter the hydrological cycle and water resources. Rising temperatures have caused glaciers to melt and retreat faster and smaller glaciers may disappear altogether. In Nepal, glaciers have been retreating rapidly for the past few decades. A UNEP/ICIMOD study 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 in five to ten years time with catastrophic results unless urgent action is taken (ICIMOD, 2001, Mool *et. al*, 2001, UNEP, 2002, WWF 2006). Hence, apart from landslides and river erosions, the mountainous regions are also quite susceptible to disastrous hazards due to glacial lake outburst floods. 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.

Anticipated changes in hydrological cycle and the depletion of water resources therefore are some of the top environmental challenges Nepal is going to face due to Climate Change. The water related problems as such are likely to be more severe in Asian countries like Nepal where the monsoon, characterized by high precipitation variability, is the dominating climatic force (Sharma, 1993). Snow and glaciers are not only the most sensitive physical features to Climatic Changes but also the indicator of such changes. Changes in snow and glacier area may also contribute to the creation of additional sources for Greenhouse Gases such as increased vegetative cover and increased evapo-transpiration.

### **Case 3: The Tsho Rolpa Glacier Lake Project**

The Tsho Rolpa glacial lake project is one of the most significant examples of collaborative anticipatory planning by the government, donors, and experts in GLOF mitigation. Tsho Rolpa was estimated to store approximately 90-100 million m<sup>3</sup>, a hazard that called for urgent attention. A 150-meter tall moraine dam held the lake, which if breached, could cause a GLOF event in which a third or more of the lake could flood downstream. The likelihood of a GLOF occurring at Tsho Rolpa, and the risks it posed to the 60MW Khimti hydro power plant that was under construction downstream, was sufficient to spur HMG to initiate a project in 1998, with the support of the Netherlands Development Agency (NEDA), to drain down the Tsho Rolpa glacial lake. This effort was led by the Department of Hydrology and Meteorology (DHM), with the technical assistance of Reynolds Geo-Sciences Co., Ltd. of Britain, supported by the UK Department for International Development (DFID). To mitigate this risk, an expert group recommended lowering the lake three meters by cutting an open channel in the moraine. In addition, a gate was constructed to allow water to be released as necessary. While the lake draining was in progress, an early warning system was simultaneously established in 19 villages downstream of the Rolwaling Khola on the Bhote/Tama Koshi River to give warning in the event of a Tsho Rolpa GLOF. Local villagers have been actively involved in the design of this system, and drills are carried out periodically. The World Bank and Netherlands government provided a loan to construct the system. The four-year project cost US\$ 3.2 million. The goal of lowering the lake level was achieved by June 2002, which reduced the risk of a GLOF by 20%.

Source: Shardul *et. al*. 2003

*Agriculture* - This sector is highly dependent on the weather, and given the low productivity increases 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 Western Regions where a greater population of the poor live, threatening food security. Due to diversity in topography, culture and climatic conditions, different cropping patterns are in use in Nepal. Extreme events such as rainfalls causing flooding and landslides, droughts, heat stress, hot winds, cold waves, hailstones and snowfalls are undesirable; in recent years, their frequency seems to have increased noticeably in the country, and long dry spells and cold waves have negatively affected the crop production. These can lead to crop failure and eventually to a famine in the country. Similarly, high humidity creates a favorable environment for the growth of fungal and bacterial diseases. In addition, some insects and pests become active and damage the crops.

*Forestry and Biodiversity* - *Forests* are the most important natural resources after water in Nepal. The majority of people use forest products as firewood, food, fodder, timber and medicines. Extensive utilization of and increasing demands for forest products have led to its dwindling both in area and quality. Further, Global Warming may cause forest damage through migration towards the polar region, changes in their composition, extinction of species etc. Observations and experiments demonstrate that an increase of just 10° C in global average temperature would affect the composition and functioning of forests (Trobe, 2002). New species combinations and hence new ecosystems may be established while entire forest types could disappear. With global warming forests could also be affected by more pests, more pathogens and more fires. The first national communication notes that vegetation patterns would be altered by changes in temperature and precipitation, which in turn would affect biodiversity in forests. Not only would the diversity of plants be affected but also the animals which live within a particular habitat. Nepal has a striking variety of species, including 60 that are currently endangered. One study has found that 2.4 percent of biodiversity may be lost with climate change.

*Health*— Global warming is expected to expose millions of people to new health risks. The most vulnerable to ill health are those communities living in poverty, those with a high incidence of under nutrition, and those with a high level of exposure to infectious diseases. The current lack of primary healthcare for large portions of the population also contributes to their vulnerability in this sector to future climate change. Because of the poor state of health services in Nepal, public health can indeed be at higher risk than before from unfavorable effects of Climate Change. Effect on human health is the outcome of several factors, the main being the environment. Human health is already at risk from a number of diseases, malnutritions, etc. Human induced Climate Change may soon become another major contributor to the spread of infectious diseases. Many vector-borne and water-borne infectious diseases are known to be sensitive to changes in climatic conditions. Present analysis emphasizes potential impacts of Climate Change on health especially on growing risk of Malaria, Kalaazar and Japanese Encephalitis outbreaks- mosquito being the vector of these diseases. Particularly subtropical and warm temperate regions of Nepal would be more vulnerable to Malaria and Kalaazar. Increase of temperature would make the Subtropical region of Nepal more vulnerable to Japanese Encephalitis as well.

### **Climate change impacts**

The temperature in the Himalayas, however, is increasing at a faster rate, which is having serious impacts on the country's glacial lakes. The Rika Samba Glacier in the Dhaulagiri region is retreating at a rate of 10m per year. This is very unusual as glacial movement is usually measured in millimeters. Similarly the

AX010 Glacier of Shorong Himal will be extinct by 2060 if the current trend continues (CEN, 2003). Rapidly melting glaciers means more seasonal variation in river flow, which will in turn result in more floods and droughts in the country. This will also result in more Glacier Lake Outburst Floods (GLOF), which can be disastrous to communities and infrastructure along the rivers. Other impacts of climate change can reduce agriculture production, loss of biodiversity, increased desertification and changes in social structure. On the positive side, Nepal has about 29 percent of its total area covered by forest, which are known to be good absorbers of CO<sub>2</sub>.

The National Communication Report states that climate impact and vulnerabilities are observed in water resources, agriculture, human health and ecosystems. The impacts of climate change on other sectors tend to be less direct and/or less immediate, and much more speculative – even though the sectors themselves are quite significant. Among the three sectors the first important sector is water resources, then agriculture, and then human health and the last one is ecosystems.

**Climate projections:** Temperature observations in Nepal from 1977-1994 show a general warming trend (Shrestha *et. al.*, 1999). 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. This finding is reinforced by observations by Liu and Chen (2000) on the other side of the Himalayas on the Tibetan Plateau. The US Country Study of Nepal (USCSP, 1997) used records from 22 stations from the 1971-1990. The results for temperature changes with a doubling of CO<sub>2</sub> are summarized in Table 4 below.

**Table 1: Projected Temperature Change in Nepal (°C)**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>Observed</b>	11.9	13.7	18.0	22.0	23.8	25.0	24.6	24.7	23.5	20.9	16.9	13.2
<b>Projected</b>	15.8	17.3	20.9	25.1	26.9	28.6	26.2	26.4	26.6	24.6	20.3	15.8
<b>Percent change</b>	32.4	25.9	16.1	13.9	12.8	14.2	6.3	6.9	13.0	17.7	20.1	19.3

Source: USCSP, 1997

Thus based on this analysis there is reasonably high confidence that the warming trend already observed in recent decades will continue through the 21<sup>st</sup> century. There is also moderate confidence that the summer monsoon might intensify, thereby increasing the risk of flooding and landslides. Therefore the most critical impacts of climate change could be seen in the following areas.

**Water resources:** The most critical impacts of climate change in Nepal can be expected to be on its water resources, particularly glacial lakes, and its hydropower generation. Climate change impacts on water resources will affect Nepal through a number of pathways, including disasters, hydropower, irrigation, and domestic water usage. These changes, in turn, could place additional burdens on the livelihoods of communities in highland regions. Climate induced risks to Water supply infrastructure and hydropower facilities are at risk from increased flooding, landslides, sedimentation and more intense precipitation events (particularly during the monsoon) expected to result from climate change. Similarly greater unreliability of dry season flows, poses potentially serious risks to water supplies in the lean season as the drier the climate, the more sensitive is the local hydrology. Changes in patterns of rainfall and river flow and more flooding and drought will make the livelihoods of poor people more precarious. Numbers of people at risk of food sufficiency and the incidence of infectious diseases are projected to increase. Impacts on ecosystems will reduce the availability to people of goods and services from them. Given that Nepal's

electricity infrastructure heavily relies on hydro power - nearly 91 percent of the nation's power comes from this source – a reduced hydropower potential might imply that Nepal will have to seek for alternative sources of power generation, including from fossil fuel sources. Of these, it is the potential increase in climate-related disasters, particularly from glacial lake outburst floods, that is perhaps the most prevalent threat.

The most significant GLOF event in terms of recorded damages occurred in 1985. This GLOF caused a 10 to 15 meter high surge of water and debris to flood down the Bhothe Koshi and Dudh Koshi Rivers for 90 kilometers, including: 14 bridges, including new suspension bridges, were destroyed; at least 30 houses, likely the only property the families had (Ives, 1986). At its peak, 2,000 m<sup>3</sup>/sec 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. An earlier GLOF in 1977 was recorded at Dudh Koshi. This event killed two or three people, destroyed bridges for 35 km downstream, and triggered many debris flows. Construction materials for a hotel that were kept 10 m above the river were swept away. The Namche Hydel site sustained such damage that it was deemed unlikely to be salvageable for any reconstruction of the plant. Severe erosion destroyed the weir and headrace canal where water would flow into the plant. The flood plain was extensively widened. This damage was not the only damage that occurred that day on 4 August 1985. Damage occurred all along the length of the Langmoche Khola-Bhothe (Shardul *et al*, 2003)

From 1954 to 2002, floods have affected over a million people in Nepal. As shown in the table below, floods killed 5,003 people (24 % of deaths from total disasters), left 69,350 homeless (45 % from total disasters), and caused damages amounting to US\$990,613 (75 % from total disasters). Disasters severely disrupt livelihoods and community development, whether they are flashfloods or slower onset events, such as drought. In fact, droughts can affect a greater number of people, and often the event does not bring assistance 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.

**Table 2: Climate related disasters in Nepal (1954-2002)**

	Killed	Injured	Homeless	Affected	Damage US \$
<i>All disasters</i>	20,927	7,794	153,550	7,053,754	1,316,413
Floods	5,003	725	69,350	1,531,125	990,613
Drought	0	0	0	4,400,000	1,000
Extreme Tem	60	210		210	
Windstorms	97	19	0	184	3600
<i>Climate related</i>	5160	954	69,350	5,931,519	1,004,213
Percentage contribution of climate related disasters to total disasters	24.7 %	12.2 %	45.2 %	84.1 %	76.3 %

Source: CRED, 2003

## Sector impacts linked to livelihoods

*Disasters:* Climate change has many serious implications for development. One of these is an increase in the number of severe weather events such as floods and droughts as a result of increase in global temperature. The link between global warming and extreme weather events is suggested by IPCC data. The IPCC has observed higher maximum temperatures up to 50 °C over nearly all land areas during the latter half of the twentieth century and an increase in intense precipitation events and risk of drought over some areas in the same periods.

Geoscientists have noted that, with glaciers retreating due to global warming, the number and volume of GLOF hazards is growing. Some of these floods have produced discharge rates of up to 30,000 m<sup>3</sup>/sec and can run for distances of 200 km (Richardson and Reynolds, 2000). In the past, these disasters have caused enormous destruction. With limited opportunities for safe and sustainable livelihoods in the mountains, population densities are growing within the river valleys where vulnerability to GLOFs increases. Population growth means there are now more people exposed to GLOFs and other climate-related disasters, and this is compounded by the expansion of infrastructure and settlements into vulnerable areas.

*Hydropower*—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 percent of total demand. Commercial businesses and industry cannot rely on these sources for operations. It is interesting to note that the industrial sector meets almost 40 percent of its energy demand through coal, which is entirely imported. As of now, electricity reaches only 15 percent 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.

*Irrigation and Domestic Water Usage* - With the dependence on agriculture, over 80 percent of all water in Nepal is used for irrigation. In fact, almost 38 percent of agricultural land (mostly in the Terai Plains) is irrigated, highlighting the importance of integrated water resource management to sustain livelihoods. Nepal's 6,000 rivers feed irrigation systems, power grain mills, and supply drinking water for villages for thousands of miles downstream.

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. 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 (USCSP, 1997).

Like many other developing countries, in Nepal urban centers are also expanding quickly. In 2000 over 10 percent of the population was now in urban areas, and this is growing by about 5 percent per year., 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 (Sharma, 2003).

**Agriculture and Food security:** As 80 percent of the Nepalese population depends on agriculture for a livelihood and follow traditional cultivation practices, relying on rainwater and the seasons, any changes in climatic conditions affecting rainfall patterns will have an adverse impact on the livelihoods of most of the Nepalese people, which means that there is always the high risk of food insecurity. The impact of Climate Change on agriculture will eventually affect the economic well being of the population because it will have either a decreasing effect or an increasing effect on the production pattern of the agriculture sector affecting in turn the economy of the country in the similarly way.

Drought has multiple effects since it affects not only water resources but also agriculture and subsequently food security. The effect of climate change and drought on agriculture and food security will have serious implications for sustainable development. Food security in developing countries is already threatened by trade, population growth, human induced deforestation and desertification. Climate change is another factor threatening the ability of people to obtain food.

Nepal's agriculture will face many challenges over the coming decades as the soils are degrading and water resources will place enormous strains on achieving food security for growing populations. These conditions may be worsened by climate change. Warming of more than 2.5°C could reduce global food supplies and contribute to higher food prices. In Nepal most of the irrigated terraces are turned into rainfed bariland and due to this the production is decreasing. Decline in food production would lead to more malnutrition and huge consequences particularly for children.

**Forestry and biodiversity:** Forest constitutes Nepal's largest natural resource in terms of coverage. The annual deforestation rate on average is estimated to be 1.7 percent with 2.3 percent in the hills and 1.3 percent in the Terai (FRIS, 1999). Similarly, the growing stocks of forest have declined from 522 million m<sup>3</sup> in mid- 1980s to 387.5 million m<sup>3</sup> in 1999. Undoubtedly, Climate Change will significantly affect natural forests. To assess potential impacts on biodiversity, climate data for 1xCO<sub>2</sub> and 2xCO<sub>2</sub> were obtained from Climate Change found that out of the 39 forest type zones categorized by Holdridge model, Nepal is depicted having 15 types (excluding snow area) under the existing Carbon dioxide (1xCo<sub>2</sub>) condition. Under 2xCo<sub>2</sub> condition, there will remain only 12 types of vegetation.

**Health:** Climate change is expected to have wide ranging consequences for human health. Increased disasters, particularly from floods related to glacier melt, would directly impact on human health. Diseases such as malaria and Japanese encephalitis may also increase their impact through expanding to new regions. One area that would be at risk of an increase in diseases is the lower flat plain of Nepal, the Terai region, which is warmer than the mountain regions. The general trend of Malaria positive cases was found to be increasing during the period 1963 to 1985, and then decreased due to mitigation measures taken. Temperatures between 22 and 32° C are very favorable for Malaria diseases to develop and complete their cycle, while those above 32-34° C could reduce their survival rates substantially. Thus the range of temperatures in Nepal is suitable for the Malaria parasites to exist and develop. Kala-azar (Visceral leishmaniasis) cases have also shown an increasing trend in the last two decades. This trend has become more pronounced in the recent years. Kala-azar reached epidemic form in eastern and central regions of Nepal especially in the Terai districts. Most vulnerable are the poor people and rural cattle keepers. Similarly, the Japanese Encephalitis occurs mainly at the average annual temperature range of 23-26° C, and increase in temperature will make the subtropical regions more vulnerable to this disease.

## Climate change adaptation Priorities

Adaptation to climate change is the area where Nepal has more stakes. Implications of the climate changes to the fragile mountain ecosystem, fresh water, and extreme weather events, agriculture, human health and others could be a serious problem for Nepal in the future. Few glacial lake out-burst events are already seen in Nepal and others such as Chho-Rolpa have been prevented from out-bursting recently. The downstream economic and societal implication of the floods induced by such glacial lake out-burst would be huge, and their likelihood will increase with climate change. At the same time Nepal lacks human resources, economic resources, scientific resources and institutional resources to cope with the negative implication of climate change, making it more vulnerable. (Shardul *et al*, 2003).

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. Each option 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 priorities identified by National Communication measures are sectoral as follows.

**Agriculture sector:** The present study of potential impacts due to Climate Change on agriculture suggests that Nepal is highly exposed and vulnerable to the risk of negative effects. These potential impacts may affect food production in Nepal greatly in coming years. The negative effects of climate change can be limited by changes in crops and crop varieties, improved water management and irrigation systems, adapted planting schedules and tillage practices, and better watershed management and land use planning. In addition to addressing the physiological response of plants and animals, policies can seek to improve how production and distribution systems cope with fluctuations in yields. Following are the adaptation strategies suggested and identified specific to the country's circumstances and linked to its needs.

- Resource conservation for agricultural sustainability
- Development of genetically adaptive varieties
- Hybrid maize program should be developed into a full-scale production system
- Crop diversification program should be encouraged
- Promotion of organic based farming
- Discourage the slash and burn agricultural system
- Development of early warning system
- Agro-forestry and forage development
- A comprehensive land use policy
- Manage the Methane emission
- Promotion of biogas as a source
- Manage the livestock production

**Water sector:** With the three main pathways of vulnerability to climate change in the water resource sector, there are numerous adaptation options. Each of the options would have varying degrees of effectiveness in securing Nepalese' livelihoods, and of course, varying costs associated with them. This section identifies possible adaptation measures and indications of costs:

*Soft measures:* Soft adaptation measures would help to reduce vulnerability, and they would provide benefits regardless of whether climate change occurs. Some of the possible measures are:

- Improve observation and forecasting
- Develop early warning systems
- Map hazards and vulnerabilities
- Increase community awareness and participation
- Promote afforestation and conservation
- Promote water conservation and market-based water allocation
- Increase irrigation efficiency

*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. Hard measures include:

- Mitigate GLOF risks
- Expand irrigation and storage
- Include reservoir hydropower for electricity development

Besides the two generic options described above, the following description includes several additional adaptive measures for Nepal.

- Understanding of the System
- Proper management of the System
- Promotion of Indigenous and Sustainable Technologies
- Promotion of Water Harvesting
- Promotion of Regional and International Cooperation
- Development of Disaster Mitigation Measures

*Bio-diversity:* Now forests of Nepal face double threats from deforestation and Climate Change. And also, forest communities and populations if fragmented and small, are more vulnerable to the new stresses brought about by Climate Change. The following adaptive measures can be undertaken in the above contexts:

- Refine climatological projection and increase the understanding of climate effect on species.
- Extensive planting of trees particularly in mid-hills
- Adaptation measures in land use and landscape management, agro-forestry and species-selection, silvi-culture in different ecological zones need to be planned.
- Promotion and protection of natural regeneration could be emphasized at local levels.
- Identify/prioritize species that are relatively vulnerable to Climate Change (endangered species, endemic species) and reforest sensitive areas with drought, heat, flood tolerant varieties
- Develop regional plans for non-reserve habitats to conserve populations and resources lying outside protected areas.
- Development and implementation of new and efficient management techniques are needed in reforestation and transplantation programs.
- Ecological research and monitoring for the source of information

*Health:* Since three diseases (Malaria, Kala-azar and Japanese Encephalitis) occur mainly in the Terai regions of Nepal, they spread through mosquitoes that flourish well in hot (up to 40° C) and polluted

stagnant wetlands. The cleanliness of the area is the most important requirement for adaptation. DDT has been used effectively in Nepal to control these diseases. However, serious consideration must be taken of the potential side effects of such adaptation measures as the use of chemicals to control mosquitoes. But Nepal has already experienced the emergence of chemical resistant mosquitoes. Hence, research and development of alternative approaches to cure and eliminate these diseases are needed. Quarantine program needs to be strengthened, and effective mechanism on eradication and disease control program should be given more emphasis. In this regard, ethnobotanical information may be useful to prevent or control these diseases. Promotion of health education for creating community awareness to diseases may be an effective adaptive measure to prevent occurrences of these diseases.

## DEVELOPMENT PLANNING IN NEPAL

Development planning in Nepal is under the responsibility of the National Planning Commission (NPC). The NPC releases annual plans and assesses resource needs, in addition to 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 with the First Five Year Plan in 1956, which emphasized building the country's transport, communication and infrastructure. This trend continued until the Fifth Five Year Plan (1975-1980), when a variety of issues were addressed, including the energy sector. With more than 80 percent of the population dependent on agriculture, which is experiencing a fall in productivity with an increase of idle labor, planners are pushing to develop industry, services, and other sectors. However there has been concern that while infrastructure and external trade is a benefit to the country, a large majority of Nepal's population does not have their basic needs satisfied. This was finally addressed in the Eighth Plan (1992-1997) when 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 country is now in the last year of the ninth five-year plan, and the National Planning Commission recently adopted the Tenth Plan (2002-2007) on 17 December 2002. The total budget for the latest plan amounts to NPR 3.3 billion (USD 41.7 million). The primary goal of this current five year plan is poverty alleviation, specifically to bring down poverty to below 30 percent of the population. At the beginning of the Ninth Plan this figure was 42 percent. HMG 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.

### Attention to climate concerns in planning documents

*The Eighth Plan (1992-1997)* : Keeping in view the significance of energy in national development, the energy sector received high priority during the Eighth Five-year Plan (1992-1997). The other specific and notable achievements during this Plan period included are Establishment of MoPE, Enactment of Environment Protection Act (1996) and promulgation of Environment and Protection Regulations (1997).

*The Ninth-Plan (1997-2002)*: The launching of the Ninth-Plan was guided by the philosophy: development for the people, with the people and by the people. It had the main objective of poverty alleviation and had prioritized agriculture, industrialization and tourism development. Environment management was further re-

emphasized to consider it as a national level policy, and the accompanying sectoral policies also included several strategies, which could contribute to improve the environmental conditions. The Ninth Development Plan was implemented with an aim to substantially reduce poverty within 20 years, with a view to empowering people economically and socially by integrating them into the mainstream of the development process.

***The Tenth-Plan (2002-2007):*** The Tenth Plan, which was accepted in December 2002 has been developed as the country's Poverty Reduction Strategy Plan (PRSP). Even more than in the previous Ninth Plan, poverty reduction is the central focus of this new development strategy. The main objective of the Tenth Plan is to alleviate poverty by mobilizing optimally the means and resources on the mutual participation of government, local agencies, non-governmental sectors, private sector and civil society to extend economic opportunities and open new ones. It aims to enlarge employment opportunities and widen the access to means and economic achievements for women, *Dalits*, peoples of remote areas and poor and backward groups through programmes like empowerment, human development, security and targeted projects thereby improving the status of overall economic, human and social indicator. Although the plan acknowledges the important influence that the weather can have on overall economic performance, explicit attention to climate risks is lacking.

***Poverty Reduction Strategy Paper (PRSP):*** Nepal has been implementing its Poverty Reduction Strategy Paper (PRSP) since Fiscal year 2002/03. Under the PRSP, a four-pronged strategy has been adopted for the achievement of the goal: (i) high, sustainable and broad-based economic growth; (ii) social sector and rural infrastructure development; (iii) targeted programmes including social inclusion, and (iv) good governance. These strategies provide a key opportunity to mobilize national actors to achieve the Millennium Development Goals (MDGs). The PRSP proposes to reduce poverty in the country through economic reform and broad-based growth, maintaining macroeconomic stability, reforming the financial sector, strengthening trade, investment, and industrial policies, better targeting of public expenditure, improving the effectiveness of expenditure on social sectors and infrastructure development, and through the establishment and effective use of the Poverty Alleviation Fund.

***Medium Term Expenditure Framework (MTEF):*** There is only one paragraph in the whole document of MTEF, where the development impacts of weather and climate are mentioned. While many of the proposed development activities may well reduce vulnerability to climate risks, explicit attention to these risks is lacking. 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. By itself, the lack of specific climate risk management items is no reason for concern. Ideally, climate risk management would be mainstreamed in many of the sectoral activities in the MTEF and the activities matrix (such as hydropower development and agriculture projects).

An analysis of 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 and emergency preparedness and disaster management, but does not explicitly discuss natural hazards and climate risks. The MTEF

paper for the road sector does not discuss flood and landslide risks, nor does the MTEF paper for water supply and sanitation discuss variability in rainfall, which may strongly affect the success of measures in this sector. Similarly, the MTEF paper for the irrigation sector does not explicitly mention climate risks. However, its list of outputs includes mitigation of floods and erosion in cultivated areas, and water harvesting to provide year-round water supply for irrigation. Both measures would fit well in an adaptation strategy for Nepalese agriculture.

The MTEF paper for the agriculture sector pays some attention to climate-related risks. For instance, it mentions the criticality of the monsoon season for the sector. On the other hand, it lists the country's "*agro-climatic potential*" as an opportunity. This framework 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 agriculture sector that are likely to reduce vulnerability to climate-related risks. The MTEF does propose simple solutions for sites where adequate and perennial water sources are lacking, including water-harvesting schemes and solar pumps. However, the real climate-related risks (what is "adequate" and how do you deal with a water source that is usually perennial but dries up during a period of drought) are not discussed (Shardul *et al*, 2003).

### **Attention to climate concerns in government policy and strategies**

Climate Change is a new thinking and concern in Nepal. The understanding of this science, its mitigation aspects, impacts and adaptation and relevance to Nepalese economy are mainly restricted to a few institutions and individuals. Since the Stockholm Declaration, various strategies for the environmental management were developed. As a result the WCS was endorsed and guided the formation of the NCS. Nepal complied with the preparation of the Strategy and finally in the year 1988 it was endorsed by GON. Since then, GON's policy on the environment has been broadly stated in a number of documents. The country has undertaken a number of environmental related measures as part of the policy of the government to achieve sustainable development path. Hence, these policy measures apart from making the process of development sustainable will also have to be undertaken to address Climate Change issues as well. Over the past decade, the response to environmental management in Nepal has been positive. GON took another policy initiative for environmental management. NEPAP was prepared and endorsed by Environmental Protection Council of Nepal. The policies adopted by Government of Nepal are NCS 1989, NEPAP 1993, Natural Parks and Wildlife Conservation Act 1973, Water Resources Act 1992, Forest Act 1993 and Environment Protection Act 1997.

Nepal's policy documents made little mentioned of climate change itself. However, sustainable development as a concept is often implicit in the country's planning. Nepal has ratified the three Rio Conventions, and prepared the national communication for the UNFCCC. Many of the policies and measures aimed to support sustainable development would directly or indirectly contribute to adaptation for climate change. Some policies and strategies and their synergies between climate change and other environmental issues are briefly noted below:

***National Sustainable Development Policy:*** Since 1957 Government of Nepal has been implementing National Economic and Social Development Plans to guide the social and economic development in the country. Increasing deterioration of natural resources and environment over the past few decades

prompted the government to seriously act on natural resource and environment conservation. The principles of sustainable development have formally been integrated into Nepal's national planning processes, incorporating the spirit of Agenda 21. Beginning with the Eighth-Plan (1992-1997), the environment agenda has continued through the Ninth Plan (1997-2002) and now into the Tenth Plan (2002-2007) as well. These principles have since been incorporated in all the major Perspective Plans, Master Plans, Strategies, Acts, Regulations, Guidelines and Rules formulated in the country since 1992 (after UNCED in Rio) in different areas such as forestry, agriculture, water resources, environmental management, and local governance including the protection of rights of women and children.

***Environment Management policy:*** Since the promulgation of Parliamentary Democracy through the Constitution of the Kingdom of Nepal, 1990, it is now the explicit policy of the government to give priority to the protection, preservation and development of environment in the country.

***The National Conservation Strategy (NCS):*** NCS is a major step to systematically develop an appropriate strategy for environment and resources conservation in Nepal. The NCS for Nepal has developed the modest conceptual framework with plan of action "to strike a balance between the needs of growing population and those of nature conservation" (HMG 1990). From the beginning of Ninth Five-year Plan (1997-2002), Government of Nepal has initiated integrated approach to inter-link between poverty alleviation, population growth and environment. These sectors were identified as critical issues of the Nepalese economy with agriculture and water resources playing major roles in the economic development of the country.

***Nepal Environmental Policy and Action Plan (NEPAP):*** After the UN Conference on Environment and Development (UNCED) in Rio, Government of Nepal established the Environmental Protection Council (EPC) under the chairmanship of the Prime Minister in 1992. Thereafter NEPAP 1993 was introduced. NEPAP focused on the following five areas: (1) sustainable management of natural resources; (2) population, health and sanitation, and poverty alleviation; (3) safeguarding national heritage; (4) mitigating adverse environmental impact and (5) legislation, institutions, education and public awareness. NEPAP was followed by sectoral action plans on water resources, forestry, and industry in 1998. Besides, Nepal has also enforced Environment Protection Act (1996), Environment Protection Rules (1997) and Ozone Depleting Substance Consumption (Control) Rules, 2001 with the objective of maintaining a clean and healthy environment by minimizing adverse impacts in the pursuit of economic development.

Also the Local Self-Governance Act, 1998, and its Rules, empower the local bodies such as DDC, VDC and the municipalities by outlining their environmental functions comprising of local-level planning of the environment, forest and bio-diversity conservation and use, and pollution control etc. The Ministry of Population and Environment (MOPE) has enforced the following Environmental Management strategies owing to the long term climate change affects:

- Enforcement of Nepal vehicular emission standards, 2056 (1999) for new vehicle import
- Emission standards for functioning vehicles have been enforced
- Registration of new two-stroke vehicles has been prohibited in the country
- Ambient Air Quality Standard have been specified
- Standards of Effluents from different kinds of industries have been specified.
- Scrap/Old equipment & Material can only be imported after the permission from MOPE
- Six Air Quality Monitoring stations (PM10, TSP, NO<sub>2</sub>, SO<sub>2</sub>, Benzene) have been functioning 24 Hrs daily

Specific to air, noise and water pollution, the government has also recommended/adopted policies on: Industrial effluent discharge, noise abatement standards, and corrective mitigation and preventive measures, establishment of air and water quality monitoring and evaluation systems

***National Agricultural Policy 2061:*** In order to encourage farmers to go for commercial production the government has approved the new agricultural policy on 2061 (2005). The major objective of this new policy is to increase productivity rate and also to protect and promote natural resources to utilize them in the interest of farmers. The new policy has been developed as an umbrella policy and other sectoral policies like tea policy would be developed under its framework. The government would introduce new Acts in the day ahead to promote agriculture and meet the objectives of the policy. The policy has strongly quoted that agricultural systems and food security have been threatened by disasters and extreme events, which partly mentions the effects of climate change. The strategies are: to protect conserve and utilize natural resources, biodiversity and environment; to minimize the negative effects of agri-chemical fertilizers on soil and water and other environmental problems to give priority or encourage production and use of organic manure, to promote in-situ conservation and participatory biodiversity park; to support in the improvement of degraded forest and wetlands for biodiversity conservation; and to use and promote agroforestry etc.

***Strategies to combat Climate Change:*** Recent agricultural strategies have some focus on combating environment and climate related adverse effects. There are basically two strategies of MoAC in this regards i.e. "Natural Resource Management: Sustainable soil management practices and organic farming, conservation of bio-diversity, IPM, pasture/rangeland and "Agri-ecological zonation to harness ecological-diversity. Besides MoAC has clearly emphasized some of the technologies and strategies to adapt to extreme climate variations like soil erosion, flooding, drought and water scarcity. The adoption strategies recommended are the Sustainable soil management practices, Low cost and rain fed agriculture like maize, millet, fruits and vegetables; Provide plastic sheet to harvest rain-water (by Dhiki system) so as to use it in winter.

***United Nations Convention on Combat Desertification (UNCCD)*** - Nepal signed the International Convention to Combat Desertification and ratified it in 1996. Nepal took active part in the UN Conference on Desertification (1977), and in the formulation of the UN Plan of Action to Combat Desertification. Nepal being a mountainous country, combating desertification is a matter of great concern both in developmental activities as well as in regional cooperation. Nepal's most recent national report was prepared for the UNCCD COP-4 in 2000. The report mentions that measures to address impacts of desertification, land degradation, and climate change should be integrated. Many of the responses to desertification, such as integrated watershed management and community-based soil and water management, would also enhance Nepal's resilience to disasters and adaptive capacity to climate change.

***Convention on Biological Diversity (CBD)*** - Nepal signed the Convention on Biological Diversity in 1992, and ratified it in 1993. The Country's Biodiversity Strategy (2002) was prepared under the UNDP/GEF Biodiversity Conservation Project. It lists several climate-related risks, such as flooding and sedimentation, as threats to biodiversity. Future climate change may increase these risks with more severe or more frequent flooding. A draft NAPA document notes that temperature and rainfall changes will affect the ecology of the mountain region, thereby greatly impacting the socio-economic activity of people living there. The report mentions that parties are to develop national strategies, plans and programmes for sustainable

use and conservation of biodiversity and integrate them into general development plans, shall identify, monitor and maintain data on components of biodiversity, shall introduce appropriate procedures requiring EIAs for projects likely to have significant adverse effects on biological diversity and shall submit reports on measures which it has taken for the implementation of the Convention, at intervals to be determined.

***World Summit on Sustainable Development (WSSD)*** - Nepal's National Assessment Report for the WSSD (2002) recognizes 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 this report discusses climate change in the context of mitigation of greenhouse gas emissions. Adaptation to climate change is not specifically addressed, although the indigenous systems of living in and adapting to challenging circumstances in mountainous areas are recognized. Curiously, the only substantive discussion of risks due to climate change is featured in a paragraph on public awareness. 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.

The 2001 Economic Commission for South Asia and the Pacific (ESCAP) Nepal Country Paper meanwhile lists the facilitation of a rapid response to natural emergencies (such as floods or earthquakes) as an important role of infrastructure. Nevertheless, it pays little attention to the risk of extreme weather to the infrastructure itself, although it mentions that rural trails often become impassible during flooding. Since even current risks are not addressed, future risks due to climate change are also missing.

***Sustainable Development Agenda for Nepal (SDAN)*** – 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 (in that order) among the constraints facing Nepal's Sustainable Development. The sectoral reports for the SDAN do not mention climate change explicitly, except for the one that contains a specific section on protection of the atmosphere. While this section recognizes the vulnerability of Nepal and lists some expected impacts of global warming, it focuses primarily on mitigation and carbon sequestration. It recognizes the need to build capacity to minimize the adverse impacts of climate change, but offers no concrete measures. Regarding the climate change, it 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, building decentralized emergency response capacity, enforcing design standards for buildings and infrastructure that take into account site-specific risks, investing in better weather and earthquake prediction systems, and, specifically for GLOFS, monitoring of the lakes and preparation of siphon materials)..

***Policy for Vulnerability and Adaptation:*** The magnitude of policies and measures for Climate Change adaptation is strongly dependent on the ability to identify extent of impact and therefore of the vulnerability to Climate Change of economic and social systems, both in space and time. While research and development activities related to Greenhouse Gas Inventory in Nepal have progressed satisfactorily, those

that address vulnerability and adaptation have yet to proceed satisfactorily. Various constraints have been identified, most important of which is the lack of technical capability to apply the results of Global Climate Models to local areas. Moreover, impacts and vulnerability studies are important for identifying and analyzing potential adaptation measures that are vital for sustainable development of Nepal, particularly for the agriculture and water resources sectors. The lack of comprehensive research in these areas therefore seriously limits the ability to make appropriate policy recommendations.

**Climate change policy:** Among the country's global environmental commitments, climate change is yet to be internalized by GON. The climate change has yet to make its way into country's major planning documents such as the Tenth Five-Year Plan (2002-2007). Climate change has also been left out of the Nepal Environment Policy and Action Plan. At the national level meanwhile Nepal has no specific policy documents dealing with climate change. It is under preparation process.

**National Adaptation Programme of Action (NAPA):** The preparation of the National Adaptation Programme of Action (NAPA) is the first official initiative for mainstreaming adaptation into national policies and actions for addressing adverse impacts of climate change and reducing vulnerability to climate stimuli including extreme events. Nepal has prepared the project document to initiate the National Adaptation Program of Action (NAPA) with participation from a multi-disciplinary team, coordinated by MoEST (Alam, 2004).

**Preparation Process:** Nepal is formulating its National Adaptation Program of Action (NAPA) with participation from a multi-disciplinary team, coordinated by MoEST. The document regarding the process for the NAPA preparation is endorsed by MoEST officials. Nepal has prepared a proposal on NAPA and submitted to the UNDP for further approval. There are two committees to oversee the technical and administrative issues, and National Study Teams (NSTs) to carry out sector-related work.

- *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.”
- *Executive Committee (EC)* — The EC will assist in day-to-day management, provide technical advice, and review progress.
- *National Study Teams (NST)*—the multi-disciplinary nature of the study areas requires teams composed of experts from a variety of government agencies, research institutions, and NGOs.

**Institutions Involved:** MoEST was established in 1995, and it is responsible for environmental protection and management in Nepal. The Environment Protection Council (EPC) includes high-level representation from other major ministries, scientific institutes and academia, and the private Nepal Case Study - NAPA Workshop - Bhutan, September 2003 sector. MoEST is also the focal point for the UNFCCC, coordinating climate change activities with the following ministries:

- Ministry of Water Resources
- National Planning Commission
- Ministry of Science and Technology
- Alternative Energy Promotion Center
- Ministry of Finance
- Department of Hydrology and Meteorology
- Ministry of Forest and Soil Conservation
- Ministry of Industry

- Water and Energy Commission Secretariat
- NGOs, industrial associations, etc.

## NEPAL INITIATIVES IN CLIMATE CHANGE AND ADAPTATION

In Nepal there are significant numbers of NGOs actively involved in rural development and natural resources management and supporting government in implementing program and policies. Because of their important roles, NGOs are found to be very effective in enhancing awareness among local communities on environmental concerns and mobilizing the locals in addressing some of the concerns of climate change.

Five years following the ratification of the UNFCCC, the Nepal Government undertook the current Climate Change Enabling Activities Project with funds from GEF; under this program a high level project SC was established. The government also set up an NCCC and four separate NSTs to prepare the country's response to Climate Change. The NCCC is chaired by the Director General of the DHM of the MoEST, while the SC is headed by the Secretary of the MOPE. MOPE is the agency serving as the UNFCC focal point and serves also as the secretariat to the EPC established in 1994 and chaired by the Prime Minister. The NEPC was instituted to serve as the highest decision making body on all matters related to the environment. Further, MoEST acts as the secretariat to the National Commission for Sustainable Development chaired by the Prime Minister.

Nepal's first bank dedicated to clean energy financing, the clean energy financial institution limited (CEFI) is to start operation in July 2006. Winrock International will provide technical advisory services for the initial two years of operation. Winrock's technical advisory services will enable the bank to build an investment portfolio. CEFI also seeks to invest in on and off grid renewable energy enterprises, clean energy base infrastructure projects and other infrastructure, including communication transportation agro processing and social infrastructure (Winrock, 2005).

Nepal Agricultural Research Council (NARC) at present has several disciplinary divisions to carry out research in many farmer-oriented problems. But they were not, in the past, viewed from the environmental perspective. Since this fiscal year (2000/2001), the Agricultural Environmental Unit started functioning in NARC. Now NARC is proposing a full-fledged Division of Environmental Sciences (In Nepali: "Krishi Watavaran Mahansakha") for looking after the climate change issues in the agricultural sector.

Recognizing the facts of climate change, USAID/Nepal has strategically created climate-friendly environment and energy programs that encourage forest restoration and increase Nepal's capacity to develop small- and medium-scale hydropower resources in an environmentally and socially sound manner. To this end, USAID/Nepal is providing technical assistance and training activities aimed at improving the policy and regulatory environment that will attract private sector investment in hydropower. These activities are concomitantly intended to strengthen local capability to conduct social and environmental impact assessments with increased public participation and involvement.

Oxfam started to reduce the effects of disasters, and the vulnerability of communities to disasters, in the Terai region of Nepal. They are working with communities, partners and local authorities to help them identify the most serious risks and prepare in advance. Activities include buying boats which are placed in strategic locations for safe evacuation. They have already been put to good use in the current monsoon

floods, evacuating people who had become stranded, and delivering relief supplies. They have also funded a technical review of embankment protection, and various designs for raising the houses of some of the most vulnerable households (Annex 1).

### *Current activities*

There are a number of projects and programmes implemented in Nepal to combat the impact of climate change. Climate change impact study on Himalayan glaciers/Tibetan plateau is initiated by WWF at the regional scale, including Nepal, China and India, where a climate change impact study will be conducted on Himalayan glaciers and the Tibetan plateau. Similarly WWF is also implementing a climate witness project to collect and document climate impact stories from the region with proper scientific validation. UNDP has initiated several projects to promote rural energy systems through solar power, biogas and improved cooking stoves. Similarly disaster management work has been carried out by UNDP, Nepal Water Conservation Forum, Oxfam, CARE, UNEP, ICIMOD and Practical action. All these activities are focused on increasing resilience of poor communities to cope with the impacts of climate change. Similarly LI-BIRD through support from CLACC and IIED is carrying out studies to document impacts of climate change on human health.

Organizations are also instrumental in conducting awareness raising activities through the radio program. WWF and Practical action Nepal is raising awareness on climate change and its impact to the communities, students and stakeholders. Clean energy Nepal is raising awareness to school and college students and prepared the newsletter and Government of Nepal is trying to incorporate the climate change issue in education programs for secondary schools (Annex).

Recently Climate change network Nepal was established among the organizations involved in climate change work in Nepal. Currently it has 9 member organizations which are UNDP, IUCN Nepal, WWF Nepal, JICA Nepal, Clean Energy Nepal, ICIMOD, NTNC, Winrock International and Practical Action Nepal.

### *Initiatives by MoEST*

Nepal has recently established its Designated National Authority under the MOEST and is not yet in a position to play a promotional role. National Strategy on CDM is already prepared and operationalized. MoEST is formulating and updating national programs to mitigate the effects of climate change and incorporating climate change considerations into national policies. It is cooperating to exchange information related to the climate system, climate change and its consequences. INFOTERA has agreed in providing infrastructural support to strengthen the Climate Change unit in MoEST. The ministry is also working towards raising general public awareness towards climate change by encouraging the widest participation, including that of NGO sector. Similarly, the inventory of greenhouse gas for energy sector based on 1990 data under US country studies program was carried out by DHM in October 1994. It organized a workshop on UNFCCC and institutional design of the cooperative implementation mechanism of KP. There are other initiatives like supporting projects like PREGA-promotion of renewable energy, energy efficiency and GHG abatement and PINS (Project Idea Notes) and PDDS (Project Design Documents) developed for some potential CDM projects under PREGA

There are other pipeline activities of the MoEST. The pipeline activities include preparation of National Adaptation Plan of Action (NAPA) and CDM strategy for Nepal. MoEST in collaboration with UNEP has finalized a program for capacity building in climate change. National Climate Change Strategy is under

preparation. Taking into consideration the former initiatives, MOEST is planning to draft climate change policy, CDM strategy and procedures on CDM projects. MoEST is planning to organize consultation program/workshop on UNFCCC and KP provisions, including outcome of COP 12/MOP 2. Similarly, the ministry is preparing fact sheets on conventions including UNFCCC and future course of actions, DNA strengthening and CDM promotion and launching public awareness activities.

## FINANCIAL MECHANISM AND ISSUES

There are two separate financial mechanisms for financing of mitigation and financing of adaptation. For the purpose of financing the mitigation, there is the Clean Development Mechanism and for the purpose of increase adaptation to climate change in developing countries there are mainly three types of funds (LDC Fund, Special Climate Change Fund and The Adaptation Fund) are available. Funds for adaptation to climate change in developing countries were announced in 2001. Three Marrakech funds were established (Huq and Reid, 2004, Munasingle and Swart, 2005).

The LDC and SCC funds were established under the UNFCCC and are operated by the GEF. Contributions to these funds by industrialized countries are voluntary. Global Environment Facility (GEF) is the "financial operating entity" of the convention and with the help of UNEP and UNDP is supporting non-Annex1 countries under its 'enabling activities'. Nepal has received 0.31 million US\$ (in *full cost* basis) from GEF through UNEP to carry out the stage-I activities related to the climate change (UNFCCC, 2000a). USCSF has also contributed some climate change related activities in Nepal. USCSF was launched in 56 countries which was originally announced by then-president George Bush at the United Nations Conference in Environment and Development (UNCED) in Brazil in 1992 (Joseph *et al.*, 1995). Under this program preliminary GHG inventory was constructed for Nepal, the mitigation options of GHG emissions in energy sector was identified and vulnerability/adaptation assessment for water resources and agriculture were carried out (DHM, 1997).

Although MoEST is the principle focal point and the entire fund for the climate-related activities is channeled through MoEST in the case of Nepal, we have not been able to capture the fund for climate change adaptation and mitigation. There is funding to prepare NAPA but due to the country's political unrest and government's slow movement, we have not been able to trap the LDC fund to fund the priority areas for adaptation. Therefore the foremost importance for receiving the fund is preparation of NAPA and NCSA. In this context MoEST should consider NAPA as an integrated project and need to consider each and every aspect of different projects. The climate change component should be included in each and every projects and priority of government programme and policy. The political instability and frequent changes in the government program and policies including the institutional structure, human resources and financial priorities is often an obstacle in expediting the NAPA formulation process. There are very rapid reshuffling and transfer of officials within the ministries which is the major cause for delay in implementation of the climate change related works. At these current days the priority of the government is peace building, governance and poverty reduction. The work of the government is also focused on creating stable government and economy and providing basic services to people. In the last decade government has invested in military equipment and internal conflict resolution. The ministry of environment and its program are often at the low priority of the government compared to other sectors.

Nepal is a resource poor country and it is not possible for the country to conduct all the works from its own resources. The support of donor agency is very necessary. Although there are lots of supports from the

different donors in past but the government has other priorities than climate change. In this context, climate change could not also reach in the priority areas of donor and government. For example Nepal is not included in the priority area of DFID, USAID, DF and SDC. GEF fund was focused on implementing CBD and other international conventions and the part of the fund received under climate change was involved more on the management cost and so not sufficient to reach in developing countries like Nepal. Most of the donor's fund is invested in the action of peace building and security.

As the NAPA is not prepared yet, the government could not identify the priority adaptation actions for further funding. Therefore Nepal could not capture the SCCF for adaptation projects and mitigations. However, the government has realized the importance of environment and considers the climate change issue in the national policy. In the context of Nepal this is broadly focused on three dimension i.e. science, climate change evidence and policy. Nepal does not have sufficient data base, sufficient capacity for international negotiation and lobbying at international level (negotiation power), institutional framework, any specific policy and strategy regarding the climate change. These are all pre-requisites to be eligible for the fund. Government should also develop the database (how much impact climate change has and in which sector), identify or make clear vision and strategy on climate change. The government should also conduct the vulnerability assessment and identify the most vulnerable sector and area and allocate resources to fund priority areas.

The adaptation fund was established under the Kyoto Protocol and is funded through a 2 percent levy on the proceeds of CDM transactions applied in effect by reducing the certified emissions reductions transferred to the investor. Although not applied to CDM projects in LDCs, the levy has been criticized because it places the CDM and thus developing countries at a disadvantage relative to emissions trading or JI in the international market for investment in emissions abatement (Huq and Reid 2004). The fund is limited, insignificant and complicated mechanism, so there is difficulty for countries like Nepal to have access to the fund. Therefore, there is need to make a most user friendly mechanism, categorize vulnerable countries and allocate the fund based on degree of vulnerability.

There is the Clean Development Mechanism for financing the mitigation which is also complicated in the context of Nepal. It is necessary to go the CDM and GEF in parallel but it is not possible at present. For CDM projects, applying and monitoring procedure is complicated. For example there is complicated process in making proposal because it needs verifying and evaluation of project which is much too costly and it is not possible without the support of external agency like donor agency. If there is simple mechanism for identifying the priority areas then it would be applicable for Nepal for receiving more funds. Similarly, there is higher potential of promoting bio-gas as clean development project. At the negotiating table Nepal must push for revising the current guidelines and framework to include biogas. If so then there will be sufficient fund for Nepal to invest in its priority adaptation and mitigation projects.

## **CLIMATE CHANGE CONCERNS IN DONOR ACTIVITIES AND STRATEGIES**

The extent to which climate risks affect development activities in Nepal can be partially gauged by examining the sectoral composition of the total aid portfolio. Development activities in water resources, as well as sectors such as agriculture, and health could clearly be affected by climate change and current climate variability. At the other end of the spectrum, development activities relating to education, gender equality, and governance reform are much less directly affected by climatic circumstances.

In principle, the sectoral selection should include all development activities that might be designed differently depending on whether or not climate risks are taken into account. Therefore, the label “affected by climate risks” has two dimensions. It includes projects that are at risk themselves, such as an investment that could be destroyed by flooding. But it also includes projects that affect the vulnerability of other natural or human systems. For instance, new roads might be fully weatherproof from an engineering standpoint (even for climatic conditions in the far future), but they might also trigger new settlements in high-risk areas, or it might have a negative effect on the resilience of the natural environment, thus exposing the area to increased climate risks.

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, UNDP and IFAD, as well as bilateral donors such as DFID and 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 are also missing.

Several of these documents however, do implicitly acknowledge the potentially of large impacts of climatic factors on the success or failure of development investments. In World Bank's economic update of Nepal, when discussing priorities for the agriculture sector, the need to improve the resilience of the agriculture sector against adverse climatic conditions is ignored. A similar gap can be found in the ADB's Country Assistance Plan. Climate risks are also not explicitly mentioned in USAID's and DFID's country strategies for Nepal. 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. Climate change is only mentioned in the context of the mitigation potential of hydropower development. DFID's Country Strategy Paper for Nepal (1998) presents a similar picture as the World Bank and ADB strategies: an ample component that may well contribute to reducing Nepal's vulnerability is mentioned but no explicit attention was paid to climate risks.

United Nations Development Programme'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 on those goals. However, a few crosscutting themes, including disaster mitigation, were 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.

The IFAD Country Strategic Opportunities Paper (CSOP) addresses several aspects of vulnerability in the hill and mountain areas of Nepal, but pays little 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.

An important point to note is that the lack of explicit mention of climate risks does not necessarily mean a lack of attention to climate change: several strategies mention the mitigation potential of Nepal's hydropower and forestry sector. No win-win options for combined adaptation and mitigation (for instance by afforestation) 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 over the past decade. Therefore, even if donors do not explicitly link GLOF risks to climate change per se, they are in fact actively engaged in devising adaptation responses to one of the most critical climate change related hazards for Nepal. This also highlights the limitation of mentioning “climate change” in project documents as a proxy measure to assess the significance the government or donors might attach to devise appropriate responses to some of the impacts associated with it.

### Climate change concerns in donor portfolios and projects

Nepal receives large amounts of donor aid which is between US\$ 350 and 400 million of development assistance annually or about 7 percent of GNI. The largest donors, in terms of overall investments, are Japan, the ADB, and the World Bank (IDA). Consequently, foreign aid also accounts for the loan share (70%) of development investments in the country. Hence, while the overall development agenda is set by the government of Nepal, the donor agencies have quite a strong say in the strategic choices and ways of implementation of the vast majority of development investments. An analysis of donor projects in Nepal using the OECD/World Bank Creditor Reporting System (CRS) database reveals that roughly 50-65 percent (in terms of investment dollars) and 26-33 percent (in terms of number of projects) of donor portfolios in Nepal are potentially affected by climate risks. This includes both activities in sectors which may be impacted by climate change, as well as those development activities which may influence the vulnerability of natural or human systems to climate change. These numbers are only indicative, given that any classification based on sectors suffers from problems related to over-simplification. Nevertheless, such measures can serve as a crude barometer to assess the degree to which particular projects or development strategies may need to take climate change concerns into account.

Despite discernible impacts that can be related to climate change, Nepal has generally not received sufficient attention or funding from international communities on adaptation to climate change. Meanwhile, on the development side, an analysis of donor country strategies and project documents reveals that such documents also do not mention climate change explicitly. Yet, field visits and consultation with government officials and donor representatives present a more nuanced picture. Efforts are in fact underway to manage at least some of the risks, such as GLOFs, as part of their ongoing development projects and plans – albeit in a narrow engineering sense.

## INSTITUTIONAL ISSUES

One of the most urgent problems that Nepal faces is lack of technical, human resource, and financial capacities. This affects Nepal's ability to formulate and implement programs for achieving sustainable development. It also creates disadvantages at the international negotiation level. The following areas are constraints for further strengthening or reducing the climate change vulnerability and increase resilience of people at institutional level.

- *Lack of information and data* - Regarding information and data, there is not so much data on adaptation and climate change issues as limited studies have been carried out. Further Nepal lacks an immaculate data collection and management system. With the numerous micro-environments in mountainous areas, it is difficult to project the changes that will occur in the coming decades.

- *Lack of public awareness* – As climate change is a new concept in Nepal, people are not very aware about it. There is also lack of awareness at different level i.e. from grassroot institutions to national level institutions.
- *Lack of trained human resources*: One of the most urgent problems that Nepal faces is the lack of technical human resource. Likewise there is frequently change in the focal person so making it difficult to find the trained human resource. Due to lack of understanding and skills in the overall climate negotiation process, Nepal is marginalized in the negotiation process. In the context of Nepal very few people have experience in the topics as well as negotiations.
- *Lack of inter-departmental coordination* – Inter departmental coordination is lacking under the same ministry as well as within other ministries implementing other UN conventions.
- *Lack of regional and international collaboration* – Most of the climate related works need regional as well and international collaboration for example GLOFs often originate outside of Nepal so the solutions to tackle the problems will often require regional cooperation and information sharing about the watersheds. There is less regional and international collaboration. There is a lack of collaboration within government ministries and across donors.
- *Low financial capacities*: Nepal has low financial capacities and received limited resource and assistance from the donors to tackle with the impact of climate change.
- *Less focus on national policy*: Nepal has experienced several barriers in implementing policies related to climate change and extreme events. These include the lack of attention at the national policy level and low public awareness.
- *Geographic situation*: There are physical and environmental barriers for Nepal to overcome. For example, as the population quickly expands at 2.24 percent per year, the agrarian resource base is diminishing. Across the country, over half of all households rely on less than 0.5 hectares of land to support their families. Added to the uncertainties of the weather, this leaves many people in a situation of precarious food security. Natural disasters such as floods, drought, landslides, and earthquakes can completely disrupt existing development efforts. Climate change in the future may bring more frequent or intense disasters, further eroding the resilience of communities.
- *Political instability*: Nepal has been experiencing Political instability and insecurity for the last 10 years. An immediate critical issue is the severe security problem the country is facing due to an ongoing insurgency and political turmoil. The current political instability has even created chaos in the country.

#### **Mainstreaming climate concerns in development planning: constraints and opportunities:**

Preliminary discussions with regard to prioritization of adaptation strategies and their mainstreaming with national stakeholders revealed that development priorities and climate responses can be complementary instead of orthogonal. For example, setting up micro-hydro generation facilities serves multiple development goals, including rural development and employment of women, in addition to serving as an effective diversification strategy for GLOF hazards. On the other hand, there are instances where climate risks and development paths might be on a collision course. For example, the construction of new roads, frequently in river valleys is encouraging settlements in precisely those areas that might be more vulnerable to flooding. Another critical issue for Nepal, where competing environmental and development priorities lead to conflicting priorities, is the case of storage hydropower. The growing demands for water and electricity, coupled with reduced dependability of low season flows under climate change would suggest the need for a greater role for storage hydro facilities as an adaptation response, as opposed to the conventional run-of-river schemes. Construction of dams, however, is currently not being encouraged, in large part due to other environmental risks posed by them. While addressing one impact of climate change

(low flows), dams might in fact exacerbate societal vulnerability to another climate change impact (GLOFs), because the breach of a dam following a GLOF might result in a second flooding event. These scenarios all reflect that there must be synergy between climate risk mitigation project with sustainable development and poverty reduction projects.

### **Status in International and Regional Cooperation**

Climate Change is a very important but critical global environmental issue of concern facing mankind. While dealing with this international concern, Nepal as a small developing country likes to believe that taking collective action based upon the convention principle of "common but differentiated responsibilities" is the only solution to the problem. Consideration of the extent of efficiency in any undertaking and the aspect of equity status must be taken into account simultaneously as well as carefully when the country tries to pursue or formulate policies and measures related to Climate Change. As far as possible, Nepal though a Non-Annex I Party likes to participate and cooperate in all possibilities within the Framework Convention in international and regional activities dealing with this Climate Change issue. Looking back on the technical aspect of this global phenomenon of Climate Change, Nepal was first involved and participated through a bilateral cooperation in studies and development of the country's national GHG emission inventory and to some extent mitigation as well as vulnerability and adaptation aspects in the mid of 1990s.

Considering the availability of opportunities under the provisions of UNFCCC, Nepal is conducting a pilot AIJ project in cooperation with an Annex I Party to conduct Methane emission mitigation project. The project was supposed to be implemented in early 1990 however couldn't materialize due to lack of sufficient support. In the meantime, a Country Study Program in Climate Change with financial and technical support from the US was launched successfully and completed in late 1990s.

The Climate Change problem obviously is multi-dimensional and needs active participation from countries worldwide. Nepal believes that regional cooperation and sharing of experiences and information can also be very instrumental in this direction. Obviously at present, SAARC at the sub-regional level has been trying to stand as an important forum for offering and sharing support for the member country's commitments in meeting the UNFCCC obligations. SAARC could mobilize cooperation from the member countries and focus their efforts and understanding in conducting research and studies on Climate Change issues and problems. The closeness or similarity in the aspect of the SAARC cultures and economies built up will have immense potential in formulation of Climate Change modules and their application to the region. Mutual understanding and cooperation as such may have optimum advantage in the use of resources needed for developing complicated climate models in the analysis of multidimensional scenarios. Capacity building processes and efforts can be accelerated in this region by this mechanism of information and experience exchange.

### **CONCLUSION**

Global warming is gradually becoming a major concern to mankind. Climate change is recognized as a threat to communities in the highlands and plains who depend more on the natural resources such as water and biodiversity. Most of the people, who are most vulnerable, are not aware of the real consequences of global warming. Although Nepal's present contribution to Climate Change is negligible compared to the

developed countries and some larger developing countries, it remains vulnerable to the economic, ecological and social impacts of Climate Change.

Of late, the mountain region is experiencing an increasing frequency and intensity of extreme climate events such as Glacial Lake Outburst Floods (GLOF), flash floods, monsoon floods and cloudbursts, which in turn bring down huge amounts of sediment and large boulders thereby causing widespread damage to property and life in downstream. Other phenomena including receding glaciers, atmospheric brown cloud, and winter fog in the Terai region are known to adversely affect various climate-sensitive sectors such as agriculture and water resources. The traditional resilience of the region and its people is rapidly being eroded by a growing reliance on and over-exploitation of natural resources, threatening sustainability.

Agriculture remains the backbone of the economy providing livelihoods for over 80 percent of the population and in order to contribute to climate change adaptation, its development should take place in such a way as to improve livelihood security, in particular among the poorest. Nepal's vulnerability to climate change is clearly tied to its water resource management over the next several decades. Water resources are linked to livelihoods and development through hydropower, irrigation, health, and disasters. Changes in hydrological cycle and the depletion of water resources are some of the top environmental challenges facing Nepal in the context of global warming. Forests of Nepal have been shrinking mainly because of anthropogenic activities.

Nepal is now moving towards integrating climate change and other environmental concerns with development planning. It is quite difficult to implement any policies and measures unless the public has deep perception and appreciation of the climate change issues. Political and socio-economic conditions and circumstances again prevent the country fully understanding the government's climate change related policy formulation. There are many relevant documents, which show the gaps in the policies and process to combat climate change adverse effects and impacts particularly in agriculture and health. This will definitely have negative implications to the livelihood of poor and vulnerable communities who depend largely on agriculture, natural resource management and who have economically less capacity to counter the problems.

Most of the developing countries including Nepal lack the institutional, scientific and economic resources to adapt to the climate changes making them more vulnerable to climate change. Recent incidents of the glacial lake out-burst in Nepal could be linked to the global climate change but in large, the implications of the climate change to Nepal and its vulnerability assessment is yet obscure. The Nepalese national communication suggests several adaptation measures based on expected changes in temperature and rainfall and resulting impacts on various sectors. The communication has thus largely focused on climatic constraints to development. In addition to having lower capital and technological requirements, comprehensive type measures are specifically targeted at the poor and most vulnerable, strengthening their present livelihood security as well as reducing their vulnerability to future climate change, such measures are critical to adaptation to climate change because poor groups who are vulnerable to impacts of climate change may not be able to access expensive technologies, such as hybrid crops.

Finally adaptation and strengthening of livelihood security are necessarily cross sectoral, since diversification is a key household strategy to cope with climate stress. Livelihood options are also affected by developments in a number of sectors, including forestry, agriculture, water, infrastructure, and health. Development of effective adaptation policies entails coordination between sectors, ministries and

institutions. In particular, it is important that vulnerable groups are well represented in the development and implementation of such measures.

In Nepal, as in any other least developed country, Climate Change issue is a priority only to the extent that it is reflected in the national development objectives in relation to protection of the environment and sustainable development. Therefore, unless the context of Climate Change is integrated and linked to the national development goals, priority cannot be attached to it, and hence programs related to Climate Change will not attract adequate attention. It is necessary to link Climate Change issues to Nepal's long-term development goals - poverty reduction, economic growth and employment, increased self-reliance, promotion of rural development, and preserving the environment. In order to reduce current and future vulnerability it is important that the changes being instituted do not threaten the resource rights and access of the poor to basic resources. In order to strengthen adaptation, reforms in resource access and governance should encourage equitable access to basic resources. (Sharma, 1997).

The National Communications and National Adaptation Programme of Action (NAPA) appear to be the first attempt to highlight the need and importance of integrating climate change with national planning process. Climate change risk and adaptation measures are left out in the development planning. The country's current social and political unrest has indeed made planners prioritize peace building and good governance. One of the barriers is due to lack of awareness and knowledge on climate change issues. Policy makers and planners need more concrete evidence and cases to justify that climate change adaptation is a must and should be prioritized. 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. Donors can influence such integration by emphasizing their priorities and focus while the development agencies can initiate activities for institutionalization.

Economic development policy of Nepal should not compromise with the policies to mitigate GHG emissions but Nepalese policies should try to tap the no-regret options that may exist within the economy. Active participation of Nepal is required in the UNFCCC and IPCC activities such as the designing of the CDM which might yield potential benefits to Nepal. Adaptation and vulnerability area is of considerable importance to Nepal due to its fragile mountain ecosystem, increasing urban pollution, glacial lake out-burst events and others. The enhancement of the existing knowledge by scientific analysis is required for the various issues that Nepal will face in the future due to climate change.

## RECOMMENDATION

- ✚ There is urgent need to create and maintain database at national level. Due to lack of proper database, it is very difficult to identify key climatic risk and vulnerability areas for necessary mitigation and adaptation actions. This system will nevertheless help in creating more flexibility in programs and infrastructure designs to enhance the adaptive capacity of communities. In addition, communities should have access to this information and database to strengthen their own existing coping mechanism.
- ✚ The limited research and development in climate change regime in Nepal opens scope and avenues for further research and scientific assessments and development on vulnerability and

adaptation measures particularly on water, agriculture, biodiversity and health sectors. These findings will help the scientific communities as well as policy makers to understand the potential impacts of Climate Change in Nepal with specific reference to their scale and timing and for development and assessment of appropriate adaptation strategies

- ✚ The general public in Nepal do not yet have good understanding of the implications of Climate Change and the potential benefits of the response measures. Unless the general public has deep understanding and appreciation of Climate Change issues and the implications of various options available to them, it is extremely difficult to implement new policies and measures, even if they are potentially beneficial to all the parties concerned. Therefore raising awareness of climate change impacts in the entire sector is necessary. The government needs to play a role in raising awareness about climate change issues in Nepal. Awareness and understanding of climate change impacts at community level is of foremost importance.
- ✚ Participation of different levels of stakeholders like private sector, Public sector, CBOs, Communities, GOs, NGOs, INGOs, insurance company etc. is necessary to ensure collective actions to address climate change issues.
- ✚ Capacity building is an important aspect in implementing project and programmes at national as well as community level. The dynamic nature of the topics and their scientific technical complexity require continuous exposure and transfer of skill and knowledge to the individuals responsible in the government for leading the work. Capacity building for different levels of stakeholder is vital if Nepal is to play an effective role and contribute in the global efforts to address Climate Change.
- ✚ Adaptation to climate change is vital for increasing the adaptive capacity and resilience of poor people regarding the impacts of climate change. Adaptation strategies need to be integrated into poverty reduction as a cross cutting issue and focus on the needs of people most affected by climate change impacts and aim to reduce the most important vulnerabilities they face. Therefore action on adaptation must be focused on community based adaptation strategy through mobilization of local resources.
- ✚ There is need for a coherent national approach to provide the tools and organization to understand the impacts of Climate Change as opposed to continued reliance on individual agency initiatives. Education and public awareness are important parts of the overall policy response to the Climate Change issue. Consideration of climate change and vulnerability issues in sectoral and development planning and policies is necessary through which adaptation may be promoted. Development and implement of climate change policy and NAPA is of foremost importance.
- ✚ Greater inequality among a group of people can heighten collective vulnerability. Strong links exist between inequality placing further constraints in the response options. It is therefore as important to look at the social and economic processes causing vulnerability as the possible direct sectoral impact of climate change based on changes in climate parameters. Appropriate financial incentives and disincentives need to be worked out for country like Nepal to support these activities.
- ✚ In the context of Nepal the most poor and disadvantaged group is women therefore gender should be given due consideration as a cross cutting issues in climate change.

- ✚ Nepal must give due consideration to the linkage and cooperation at regional and international level as there are some trans-boundary or regional dimensions of climate change impacts and responses for example many catastrophic GLOF events in Nepal, in fact originated in Tibet. Therefore, in addition to national discourses on linkages between climate change and development, such discussions might also be needed at a regional level to formulate co-ordinated strategies.
- ✚ Nepal has limited financial resources but vulnerability research is highly dynamic. Therefore Nepal needs substantial financial support from advanced countries. Due to limited funds, generally only *current* risks are incorporated in project planning. The evidence is at best mixed as to whether plans and projects incorporate the *increase* in risks that are projected with a changing climate. Therefore an adequate fund for conducting research to address the impacts of climate change is essential.
- ✚ The current mechanisms for funding adaptation to the developing countries are set to constrain the need to integrate adaptation across development activities. The adaptation fund is also limited. A much more flexible, pragmatic approach to funding adaptation is needed, in which rather than restricting support to stand alone adaptation projects, funding strategies facilitate integration of adaptation into all relevant development activities. In the context of Nepal Mitigation is more expensive and not more relevant to Nepal so funding should be focused on adaptation.

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## ANNEXES

### Annex 1: List of Acronyms

ADB	Asian Development Bank
AIJ	Activities for Joint Implementation
APP	Agriculture Perspective Plan
CBD	Convention on Biological Diversity
CBS	Central Bureau of Statistics
CBOs	Community Based Organizations
CCF	Country Cooperation Framework
CDM	Clean Development Mechanism
CEN	Clean Energy Nepal
CCNN	Climate Change Network of Nepal
CEFI	Clean Energy Financial Institution Limited
CFCS	Chlorofluorocarbons
CO	Carbon Monoxide
CO <sub>2</sub>	Carbon dioxide
CRS	Creditor Reporting System
COP	Conference of the Parties
CSMT	Country Study Management Team
CSOP	Country Strategic Opportunities Paper
DAC	Development Assistance Committee (OECD)
DADO	District Agriculture Development Office
°C	Degree Centigrade
DDC	District Development Committee
DHM	Department of Hydrology and Meteorology
DNA	Designated National Authority
DMP	Disaster Management Program
DFID	Department for International Development
EC	Executive Committee
EPC	Environment Protection Council
ESCAP	Economic Commission for South Asia and the Pacific
EIAs	Environment Impact Assessments
EWS	Early Warning System
FAO	Food and Agriculture Organization
FRIS	Forest Resource Information System
FM	Frequency Modulation
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIS	Geographic Information System
GLOF	Glacial Lake Outburst Flood
GNP	Gross Net Product
GNI	Gross Net Investment
Gos	Governmental Organizations
ha	Hectare

hrs	Hours
HCF <sub>22</sub>	Hydro Chlorofluorocarbon
HMG/N	His Majesty's Government of Nepal
HRD	Human Resource Development
ICIMOD	International Center for Integrated Mountain Development
IDA	International Development Agency
IIED	International Institute for Environment and Development
IFAD	International Fund for Agriculture Development
IPCC	Intergovernmental Panel on Climate Change
INGO	International Non Governmental Organization
IPM	Integrated Pest Management
IUCN	The World Conservation Union
JI	Joint Implementation
JICA	Japan International Cooperation Agency
KCA	Kanchanjanga Conservation Area
Kg	Kilogram
Km <sup>2</sup>	Square Kilometer
KP	Kyoto Protocol
LDCs	Least Development Countries
LI-BIRD	Local Initiatives for Biodiversity Research and Development
M	Meter
M	Cubic meter
Mm	Milimeter
MDG	Millennium Development Goals
MoAC	Ministry of Agriculture Cooperatives
Mo F	Ministry of Finance
MoEST	Ministry of Environment, Science and Technology
MOPE	Ministry of Population and Environment
MoP	Ministry of Population
Mt	Metric tons
mt/yr	Metric ton per Year
MTEF	Medium Term Expenditure Framework
MW	Mega Watt
NAPA	National Adaptation Programme of Action
NARC	National Agriculture Research Council
NCS	National Conservation Strategy
NCSA	National Capacity Self Assessment
NCCC	National Climate Change Committee
NEF	New Economics Foundation
NEPAP	Nepal Environmental Policy and Action Plan
NGO	Non-Government Organization
NO	Nitrous Oxide
NPC	National Planning Commission
NSSD	National Strategy for Sustainable Development
NST	National Study Team
NTNC	National Trust for Nature Conservation
NWCF	Nepal Water Conservation Foundation

OECD	Organization for Economic Co-operation and Development
PRSP	Poverty Reduction Strategy Plan
PDMP	Participatory Disaster Management Program
PREGA	Promotion of Renewable Energy, Energy efficiency and Greenhouse Gas Abatement
PINs	Project Idea Notes
PDDs	Project Design Documents
%	Percentage
PM 10	Particular Matters
REDP	Rural Energy Development Program
SDAN	Sustainable Development Agenda for Nepal
SAARC	South Asian Association for Regional Cooperation
SC	Steering Committee
\$	Dollar
SCCF	Special Climate Change Fund
SNP	Sagarmatha National Park
SO <sub>2</sub>	Sulphur Dioxide
TSPs	Triple Super Phosphate
UK	United Kingdom
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference in Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNFCCD	United Nations Framework Convention to Combat Desertification
US	United States
USA	United States of America
USAID	United States Agency for International Development
USD	United States Dollar
USCSP	United States Economy Study Program
VDC	Village Development Committee
WATBAL	Water Balance Model
WBs	World Banks
WCS	World Conservation Strategy
WECS	Water and Energy Commission Secretariat
WPGSP	Working Party on Global and Structural Policies
WSSD	World Summit on Sustainable Development
WWF	World Wildlife Fund

## Annex 2. Past activities focused on reducing the vulnerability caused due to climate change

S.N.	Project	Focus area	By whom (Institution)	Support
1	Initial Communication related to UNFCCC	Vulnerability and Adaptation assessment	MoEST	UNEP
2	Development and climate change	Development planning, policies with NRM	OECD	EPOC, WPGSP and DAC network
3	GOLF Inventory	Adaptation options	ICIMOD	UNEP
4	GLOFs research	Analysis of GLOFs risks		Austrian Development Cooperation
5	Participatory Disaster Management (PDMP)	Capacity building of the community on sustainable disaster management and adaptation to climate change	MoEST	UNDP
6	Climate change and development, focus on water resources and hydropower	Analysis of climatic trends , climate change scenario, impact and vulnerability	OECD	EPOC, WPGSP and DAC network
7	PREGA	CDM technologies	MoEST, Winrock International	The Netherlands

## Annex 3: List of ongoing initiatives in climate change

S.N.	Project	Focus area	By whom (Institution)	Support
1	Climate change impact study on Himalayan glaciers	Ngozumpa, Khumbu glaciers	WWF Nepal	WWF
2	Climate change witness	Document climate impact stories from the area of Sagarmatha National Park (SNP) and Kanchanjunga Conservation Area (KCA), action on climate issues from grassroots to policy makers	WWF Nepal	WWF
3	Rural Energy Development Program	Promoting community managed rural energy systems, local and national capacity building for decentralize energy planning and policy reform in favor of rural energy development	REDP/GoN	UNDP and World Bank
4	Strengthening disaster management capacity	Strengthening local and national capacity for managing disaster risks through trend analysis and preparation of GIS based hazard map and district disaster management plan and strengthening institutional and policy mechanisms	UNDP	
5	Power development	Banks power strategy, hydropower development policy, improve access to electricity in rural areas	USA, Germany and Norway	World Bank

6	NCSA for global environment management	Identify the priorities and needs for capacity building to protect the global environment ( biodiversity, climate change and desertification land and degradation)	MoEST	UNDP-GEF
7	Glaciers, glacier retreat and subsequent impact in Nepal	Climate impact on glacier, regional collaboration development and formulation of a coordination strategy to tackle the climate change impacts on glaciers and to address the mitigation and adaptation options	WWF Nepal	WWF
8	Increasing resilience of poor communities to cope with the impact of climate change	Increasing resilience of poor communities against impact of climate change	Practical Action Nepal	Allachy trust UK
9	Climate change and water management in the GBM basins	Awareness raising, capacity building of community	NWCF	
10	Adaptive capacity and livelihood resilience	Adaptive strategies for responding to floods and droughts	NWCF	
11	Monitoring de glaciations process to link with climate	Monitoring of de glaciations process	WWF Nepal, Ev-K2-CNR, DHM and ICIMOD	
12	Glacial lake outburst flow threats and risk mitigation work	GOLF risk mitigation	WWF Nepal, Ev-K2-CNR, DHM, and ICIMOD	
13	Community based water induced disaster management	Community based adaptation strategy	WWF Nepal, Ev-K2-CNR, DHM, and ICIMOD	
14	Early Warning System (EWS) on water induced disasters	Livelihood centered disaster risk reduction and capacity building on local communities	Practical Action Nepal	
15	SAMADHAN	Community based disaster risk management	CARE Nepal	
16	Climate change and health	Impact of climate change on human health	LI-BIRD	
17	Floods hazards	Flood hazards and vulnerability mapping	UNEP and ICIMOD	
18	Prime minister relief fund	National to local disaster management		
19	Natural hazards	Natural hazards prevention	DSCWM	
20	Flood forecasting	Flood plan mapping and flood forecasting	DHM	
21	Water induced disaster	District level water induced disasters hazard mapping, mitigation support	Department of water induced disaster prevention	JICA
22	Climate challenges	Assessment of climate change impact in the protected areas, development of adaptive strategies for communities inside SNP	WWF Nepal	WWF
23	Climate change knowledge	Knowledge documentation and coping strategies with the impacts at Jugedi Khola Watershed Chitwan	Practical Action Nepal	

24	System rice intensification	On farm demonstration and GHG emission test in NARC	DADO Morang	
25	Awareness raising program	Awareness raising about climate change and its impacts to the communities , students and stakeholders through local FM	WWF Nepal, Practical Action, CEN, GoN	WWF