

Integrated approach for adaptation to climate change

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Abstract:

Nepal's temperature is rising faster than global average with elevated rates in the high altitude regions. The precipitation is becoming unpredictable resulting in extremes. Poor people, whose livelihoods are nature based, have experienced adverse impacts of climate change and are struggling to cope to their best. Adaptation to climate change has become urgent for the poor communities. Practical Action Nepal is working to understand the adverse impacts of climate change on the livelihoods of poor communities and helping them to adapt better, by building their resilience. The community perceptions to climate change, their responses and needs were appraised. The experiences indicate that climate change adaptation requires an integrated approach including socio-economic development, environmental conservation and disaster risk reduction. The integrated programs become effective when focused within a watershed where the biophysical and socioeconomic systems are interlinked.

Climate change in Nepal:

The annual mean temperature of Nepal is increasing steadily at a linear rate of 0.4°C per decade from 1975 to 2005 (Baidya et al. 2007). This rate is much higher compared to the global temperature rise of 0.74°C in the last 100 years (1906 to 2005) (IPCC, 2007). Warming trends of the maximum temperature ranges from 0.068 to 0.128°C per year in most of the middle mountains and Himalayan regions of the country, while the southern plain regions show warming trends of less than 0.038°C per annum (Shrestha et al. 1999). However, the trend varies from - 0.06 to + 0.08⁰ C per annum showing variations and localized characteristics of climate change (Practical Action, 2008). Extreme temperatures have also been observed in recent years in addition to increase in annual averages. Days and nights are becoming warmer while cool days and nights are becoming less frequent (Baidya et. al. 2008).

There is no distinct trend in precipitation in Nepal. Observations show that high rainfall regions and seasons are becoming wetter, whereas low rainfall regions and seasons are becoming drier (HMG/N, 2004). The number of monsoon days, with early onset and late withdrawal, and the intensity of the monsoon rain have shown an increasing trend (Sharma, 2006). The precipitation extremes show an increasing trend in intense precipitation events at most of the stations studied (Baidya et. al. 2008). Nepalganj in mid-western Nepal recorded ever-highest rainfall of 336.9 mm within 24 hours on the 27th August 2006 (SOHAM 2006). The 2006 monsoon record showed the wettest for Nepalganj for the last 123 years (Sharma, 2006).

Overview of Impacts of Climate Change in Nepal:

Glacier is the much highlighted sector under impacts of climate change in Nepal. Studies show that Nepal's glaciers are retreating faster than the world average (Dyurgerov and Meier 2005) and the number and size of glacier lakes are increasing along with increase in temperature. Glacier AX010 in Shorong Himal retreated by 30 m from 1978 to 1989 (Fujita et. al. 2001), and majority of glaciers in Khumbu region retreated by 30 to 60 m from 1970s to 1989 (Yamada et. al. 1992). The increase in number and size of glacier lakes in Nepal imposes threats to Glacier Lake

Outburst Flood (GLOF) with potential to damage considerable magnitude of live and property along the GLOF occurring river bank.

Studies have shown reduction in glacier area in Sagarmatha National Park by 4.9% between the end of the 1950s and the early 1990s (Salerno et al. 2008). In Langtang area of Nepal Himalayas, it has been observed that 27.4% of glaciers coverage was lost during the period from 1988 to 2000 with more severity from 4,400 to 5,400 m asl elevation area (Sharma et al. 2008).

The melting of glacier will result into increase of discharge of glacier fed rivers initially and subsequently decrease after the snow and glacier become smaller and smaller (Shrestha 2004). Koshi river in eastern Nepal showed a decreasing trend of discharge during low flow season from 1947 – 1994 (Sharma et. al. 2000). An annual decreasing trend has also been observed in the discharge of Karnali River in mid-western Nepal from 1963 - 2006 (DHM Data). Whereas Kali Gandaki River in western Nepal increased by about 1% annually from 1964 - 2000 (Shrestha 2004). This will have serious impacts on hydropower plants, ground water recharge, agriculture and drinking water together with disturbances on local hydrological cycle and aquatic life.

The water springs in mid-hills of Nepal are drying up in the recent past. The Government of Nepal (GoN) publicly announced a decrease of 45% in spring flows which are the sources of drinking water for Kathmandu valley (Nepal Drinking Water Supply Corporation, Public Notice in Annapurna Post, 15 April 2007). The intensive monsoon does not adequately recharge the groundwater reservoirs as most of the precipitation drains out through surface runoff despite increase in total precipitation. On the other hand, the decrease in precipitation during the dry season has an adverse impact on groundwater recharging.

The frequent floods and landslides due to intensive rainfall affect the water quality. The heavy floods of 26 - 27 August 2006 in mid-western Nepal were followed by outbreaks of diseases including gastroenteritis, eye infection, and pneumonia (SOHAM 2006). Human health will be affected adversely in dry season because of lack of water for sanitation as the dry season becomes drier where there is already lack of sufficient water for sanitation (Erickson 2006).

Agriculture, the mainstay of over 80% of the Nepalese population (CBS 2001), has been affected by both warming and uncertainty of precipitation. The increase in temperature has both negative and positive impacts on agriculture. As the climate warms, farmers in higher altitudes (e. g. Jumla district, 2700m asl) can harvest two crops a year (rice – barley) comfortably. There are also potentials in higher elevations to bring new lands under cultivation. The warming in higher elevations has also created conducive climates for increasing crop intensity. However, thinning in snow deposition and retreat of snow line has created problem of water scarcity in the region. The prospects of bringing new land under cultivation by clearing vegetations have also threatened the biodiversity conservation in high altitude areas through habitat destruction, degradation, and land fragmentation. Important habitats will be displaced by crop lands. The relationship between crop yield and climate change has yet to be investigated.

Out of 2.64 million hectare of cultivated land in Nepal, only 43% have access to irrigation facilities, of which only 70%, 20% and 10% get irrigation water in monsoon, winter and spring

seasons respectively (ADB 2004). The remaining agriculture completely depends on natural precipitation. The crop yields have strong relationship with the amount of precipitation at right time. Yield of wheat and rice in Kaski district declined in 3 consecutive years (2003 – 2005) because of decrease in precipitation (Regmi and Adhikari, 2007). But flooding due to excessive rainfall also affects the crop yields adversely (Gharti Chhetri, 2005). It is more likely that the extreme climate events with associated pests and diseases will adversely affect the agriculture frequently.

Studies have shown early onset and late withdrawal of monsoon (HMG/N 2004). But the actual monsoon month and the main rice-planting month, July, is becoming erratic. Farmers from Kabilash VDC in Chitwan Nepal could not transplant rice in two consecutive monsoons of 2004 and 2005 because of dry months (personal experience). Some farmers changed crops from paddy to banana. As a perennial crop, banana is more resilient to erratic precipitation (Gurung 2007).

Extreme precipitation events account for increase in hazards. The intensity and amount of monsoon rains positively correlates with increase in water-induced hazards like floods and landslides (Min of Homes quoted in DWIDP 2006). Intensive rainfall was the main cause of landslides in Laprak (Gorkha district) in 1999 and Nepane (Kaski district) in 2006. A heavy downpour of rain on 26 – 27 August 2006 exceeding 300 mm within 24 hours was responsible for extensive flooding in Nepalganj area destroying lives and properties and costing millions of rupees for relief and rescue activities (SOHAM 2006).

No sufficient study has been conducted in Nepal on impacts of climate change on biodiversity. However, local people have observed some anomalies in plants growth patterns such as sprouting and onset of flowers. Gyalpo Gurung, a local resident from Humde, Manang has observed earlier greening of pastures in high altitudes (3,000 – 4,000 m asl) than the normal season (personal interaction). He has observed emerging of new pine forests on de-glaciated and glacial retreated areas. The impacts of such phenomena on livelihoods have yet to be understood. However, it is likely that the biodiversity in high altitude areas will be much affected by climate change as the soil productivity is poor to support plant growth and there is a limit for space for further upward shifting. Such vertical shifting of ecological zones will affect both flora and fauna of high altitude through habitat destruction.

The First Communication Report of Nepal to IPCC showed increasing evidence of Malaria, Kalajar and Japanese Encephalitis (HMG/N 2004). However, their correlation with global warming is yet to be understood. In several locations of high altitudes, local people have experienced an increasing trend of insects which were not there in the past, and many of them are disease vectors like flies and mosquitoes.

Community perception on climate change and its impacts:

Local people living in high altitude areas have experienced increase in temperature. A number of indicators have been used by them to justify temperature rise. These indicators include glacier melting and retreating, disappearing of snow from the mountains, shifting of cultivation line upwards, elongated growing season, early sprouting of grasses in the pasture, decreasing snow fall compared to the past, incidences of flies and mosquitoes for extended periods of time, appearance of new and disappearance of local bird species, etc.

Similarly in lower altitudes, the indicators of temperature increase include early sprouting of plants, shifting of fog-line in the valleys towards higher elevations, presence of mosquitoes for extended months instead of summer months only.

The local people have also experienced changes in the precipitation. In higher altitudes, there are more rainfall events with larger drop size and less snowfall. But the local people have different perception on the total annual precipitation. Compared to the past, the rain and the snow cannot be predicted and can occur at unusual times. Evidences of hail have also increased. This is also the same case in lower elevation areas. The intensity of monsoon rainfall has increased. People have experienced that the rain is not on time when required. There are extended dry periods during winter, the dry season.

A number of impacts have also been experienced by local people due to climate change. There is less water flow in local rivers especially during dry season. The agriculture is adversely affected due to lack of irrigation water as the local water sources are drying up as a result of less snow deposition in the mountains. In the higher altitudes, crops have also been affected by new diseases. The drying up of rivers has affected adversely the local watermills and micro hydro plants especially during dry season. The water stress has resulted into dropping off of immature apple fruits. On the other hand the increase in events of rainfall instead of snowfall has affected the earthen roofs of traditional houses in high altitudes. There is more and more seepage from the roofs and local people are replacing the earthen roofs with Corrugated Galvanised Iron (CGI) sheets which has threatened the local architecture. The increase in rainfall events has increased events of flashfloods and landslides with increasing trend in damaging infrastructure such as trails, bridges, irrigation canals, cultivated lands, etc. Traditionally local people are not prepared for some of these events which expose them to potential disasters. Local people repair through community approach when such damages occur. But now there has been increasing trend in such damages and the traditional practices are not able to repair. This has challenged the traditional knowledge and practice systems.

In hills, people have noticed increasing trend of landslides, flashfloods and erosion, whereas flood is the main hazard in the plains. A number of non-climate change factors such as development activities, might also be responsible for some of these events. However, local people perceive that changing rainfall patterns is equally responsible.

Some households who depend on herb collection for livelihoods have experienced disappearance of herbs plants in the pasture. However, this has to be further studied to identify whether it is due to change in temperature and precipitation or due to excessive collection by the people.

In high altitudes, local people have also realized some positive impacts of climate change which include increase in the length of growing season that provides opportunity for increasing crop production. As the cultivation line is shifting upward there is also opportunity to bring new lands under cultivation for increasing production. However the other side or the impacts of bringing new lands under cultivation in higher altitudes are to be assessed from environmental and socio-economic point of view.

Need for building the resilience:

A brief need assessment among the local people identified that water resource and related livelihoods are becoming their main concern. The traditional agriculture is affected by erratic rainfall, rise in temperature, emergence of new diseases and destruction of irrigation facilities, and agriculture being their main way of livelihoods, the next concern for the local people is to seek technologies that help strengthen the agriculture in the area. However, as the agriculture fails and the households become difficult to meet their needs, they are also looking for alternative livelihoods and income generation activities. They have also identified disaster risk reduction activities including forest conservation and reforestation, as one of their main need under the circumstances of growing events of flashfloods and landslides. The need for forest conservation is realized basically for minimizing soil erosion and landslides that have been occurring due to increase in rainfall events.

Climate change is a new phenomenon that is enhancing some of the prevalent hazards like drought, floods, etc. Although local people are aware of climate disturbances and their impacts in their area, they are not fully aware of global and local climate change, its potential impacts and needs for adaptation. Need for awareness raising has been realized. The issue of climate change has to be integrated into local development activities for which the local institutions need re-organisation to accommodate climate change issues.

Integrated approach for climate change adaptation:

Experience of Practical Action in Nepal shows that integrated approach is required for adaptation to climate change as the impacts of climate change is multifaceted. Such adaptation practices should be designed and implemented at community level or local level as the climate change and its impacts are localized. The needs for adaptation are also local specific although they can be broadly categorized. The major technical sectors for adaptation to climate change might include diversifying agricultural crops, alternative livelihoods, disaster risk reduction and natural resources conservation. At the community level, awareness and strengthening the institutional capacity of the communities are essential as prerequisite for climate change adaptation. Whereas climate change adaptation needs to be mainstreamed through all sectoral programs at policy level. The following paragraphs highlight the major activities that Practical Action adopted for community based integrated climate change adaptation.

The experience described here is based on project activities implemented in a hill district. However during the course of studies, the impacts of climate change in higher altitudes have also been found to be of similar nature. The exact technologies will be definitely different depending upon the location for actions; however, the approach might be applicable for adaptation to climate change at community level.

Awareness Raising:

The first intervention into the communities for adaptation to climate change was through awareness raising on climate change. The primary focus was the target communities and the students of the communities. The activities included sharing of information on global climate change, its causes and impacts. The imperatives and approaches for mitigation and adaptation were also shared with the communities. During the awareness process the community perception of local climate change, its impacts and their responses were appraised. Such exercise helped the

communities relate their observations with global information and understand the local climate change and need for adaptation. The awareness activities also helped enhance the planning process for adaptation by identifying the community problems related to climate change, identify the gaps and interventions and resources including local knowledge and practices.

The next target for awareness raising on climate change was local government and non-government stakeholders who are directly or indirectly the service providers to the communities. Understanding of the stakeholders towards climate change was appraised. In most of the cases they did not see any significant difference between environment and climate change. So they were viewing climate change as a part of environmental degradation, which was not exactly the same. Then information on global climate change and on the need for mitigation and adaptation were shared with them. Focus was also given on how they can support the communities in the process of adaptation to climate change.

Varied materials and approaches such as slides, films, field observations, leaflets, pamphlets, etc were used to make the target population aware on climate change.

Institutional Setting up:

Climate change was an unrealized issue to the communities that needed to be looked from a different angle. To mainstream the climate change adaptation into local development process, the existing institutions were not prepared. The community also realized the need to reorganize the existing institutions. The community where Practical Action worked had a number of institutions most of them being saving and credit groups. These groups were on settlement basis. A watershed level committee was formed which was represented by all the settlement within the watershed (catchment). This committee became the main focal institution for planning and implementing climate change adaptation activities within the watershed. The committee was registered at the district government office to be recognized as a legal entity. A number of activities were undertaken to strengthen their capacity in climate change adaptation. These activities included institutional development, financial management and technical management. This committee got involved in all the stages of activities - identifying the issues related to climate change, identifying activities, planning and implementing them.

Agriculture Diversification:

Rural agriculture is nature based. Agriculture is also the mainstay of the people. It is the one which is foremost hit by impacts of climate change. The first priority of the communities was to get support in agriculture. The interventions included basically to diversify crop species and varieties that can best perform under erratic rainfall and water condition. Grain crops are the priority of the communities. If specie cannot grow their preference go to the next grain crop. In the project area, the communities' first preference was to grow rice. But in several plots and for consecutive years they were unable to grow rice because of lack of rainfall on time. They tried to grow maize and millet. When the annual crops failed, the farmers opted for perennial crops like fruit crops. In their experience perennial plants or crops can withstand erratic rainfall situation better than the annual crops. So the farmers were supported to diversify their crop species and varieties to adapt to different local conditions associated with climate change and its impacts.

Income generation and alternative livelihoods:

Within the agriculture, supports were also given to the communities to diversify their crops for income generations. Vegetable crops in off-season which fetch good market price were promoted. Such activities helped diversify the farm activities and increase the income which helped in food security and spread the risk of failure of main crops under uncertain climatic condition. Also the farmers are looking for short season crops to avoid the risk of being damaged by uncertain weather conditions. Since the longer the crops stay in the field, the more it is exposed to being damaged by uncertain weather conditions.

The other activities that were promoted for income generation and livelihood diversification were goat raising, fruit cultivation, post harvest technologies of the agricultural products, community dairy development and off-farm income generation activities.

Rehabilitation of irrigation canals

The direct impacts of climate change on agriculture have been observed through disturbances on water resources management, either from irrigation canals damaged by floods or from not having rain on time. Traditionally local communities repair their irrigation canals when the floods wash away. But since last years the impact of flood is frequent and severe and the communities are unable to rehabilitate their traditional system and resources. Moreover, the water in the sources was drying up and couldn't be diverted to the canals with the existing practices. As a result, despite the need and importance of the irrigation canals, local people could not rehabilitate them. Their agriculture was adversely affected. The rehabilitation of irrigation canal was on the priority list of the communities as well. Once the canals were rehabilitated, the communities were able to continue their agriculture activities and diversify the crops for both home consumptions and income generation.

Soil and Forest Conservation:

Local people practice cultivation on slope lands without any terracing. Under such practice, the soil gets extremely dry when there is no rain for long time; on the other hand it gets eroded when there is intensive rainfall. The soil erosion on the hill slopes upstream is one of the main causes of destructive flashfloods downstream, while the lands under cultivation deteriorate severely from its productivity point of view. Such problem was increasing because of increase in extreme weather conditions. In order to help conserve the soil, Slope Land Agriculture Technique (SALT) was promoted. The technique included multipurpose plant species which helped increase fodder production for livestock and income for the households in addition with helping to stop the soil erosion.

Similarly, there was a lack of proper forest management. The forest management system was strengthened by establishing Community Forest Users' Group, registering them at the District Forestry Office to get legal entity and authority. The forest management helped the communities' access to forest products such as fodder and fuel which reduced illegal practices and ultimately helped improve the forest condition and reduce the soil erosion.

Disaster Risk Reduction:

In Nepal, climate change has posed a high degree of disaster to the local people through diverse range of hazards including floods and droughts. The local people have perceived that they are exposed to flood as the intensity of rain is increasing. So they proposed activities that help

minimize their exposure to flood. Such activities included basically putting dykes and check dams at strategic sites along the river, and planting trees on the slopes to minimize the landslides and protect lands along the river banks.

Conclusion:

Climate change has undermined the livelihoods of the people. The poor are the most vulnerable to adverse impacts of climate change as they have limited resilience due to lack of access to resources.

Increase in temperature and erratic precipitation are found to be the two main variables of climate change that are active in the study areas. Both variables are affecting the livelihoods of the people directly or indirectly. The effects are either solely related or a product of the two factors. It has been observed that climate change and its effects are localized, indicating the need to understand local climate change and applying the actions at local level through community based adaptation approach.

Water resource was found to be most affected both by increase in temperature and erratic precipitation. In high mountainous regions the water resource is becoming crucial as the water discharge in the rivers and springs are declining especially during dry season due to decreasing trend in snowfall and rapid melting of snow and glaciers deposits.

Both changes in temperature and precipitation have affected agriculture, the mainstay of most rural population. The erratic precipitation has also increased the water, induced disasters including landslides and flashfloods that are ultimately affecting the infrastructure at local levels.

The communities have been observing the climate anomalies, have been experiencing the impacts and are responding to their best. However they are not aware of global climate change, its potential impacts and the need for adaptation. The government and non-government stakeholders at local levels are also not adequately aware of climate change. There is an urgent need to raise the awareness on climate change especially the local climate change, its impacts at local level and the specific adaptation measure at local level.

Climate change is affecting all development sectors. Experience shows that the adaptation measures require an integrated approach including agriculture, water resources management, soil and forest conservation and management, disaster risk reduction and diversification of livelihoods strategies of the communities. It is also essential to mainstream climate change into all development sectors with a view that climate change and its impacts affect development and vice versa.

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