

Impact of climate change and possible strategic programs for building climate resilient communities in Nepal

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ABSTRACT

Impact of climate change in Nepal has been cited in technical reports and research publications with different perspectives. Literature review clearly suggests that the increase in temperature has been observed higher in the high mountain region than the other ecological zones. It has also been reported that the rainfall patterns are being altered resulting delayed monsoon, erratic rainfall and shorter rainfall duration. The season to season increasing and decreasing trends of pre-monsoon, monsoon and post-monsoon precipitation are also reported to be not consistent. In general, frequency of high intensity rainfall is in increasing trend.

Climate change impact has resulted in several outcome risks out of which landslide, drought, floods including glacial lake outburst floods (GLOFs), debris flows, soil erosion, and river bank cutting are at the forefront in geologic perspective. These hazards and their consequences are found to have different extent in different tectonic zones of the Nepal Himalaya. This paper first takes stock of the state of climate change impact followed by government's climate change adaptation initiatives. This paper then proposes possible strategic programs as a means of making the vulnerable communities' climate resilient in Nepal.

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INTRODUCTION

Over the last 100 years, the warming in the Himalayas has been much greater than the global average of 0.74°C (Du et al. 2004; IPCC 2007). An analysis of temperature trends in Nepal for the period of 1971-1994 has indicated a continuous warming at an average annual rate of 0.06°C which varied spatially as well as according to seasons (Shrestha et al. 1999). For example, average annual temperature in the Terai region has been increased by about 0.04°C/yr, whereas it is about 0.08°C/yr in the middle mountain areas. The pre-monsoon season (March-May) has showed the lowest warming rate of 0.03°C/yr, while the post-monsoon season (October-November) has showed the highest one of 0.08°C/yr (Shrestha 2001). Similarly, another trend analysis conducted for the period of 1976-2005 has indicated the annual rate of warming to be 0.04°C (Practical Action 2009). Besides, the General Circulation Models run with the SRES B2 scenario has shown the mean annual temperature to increase by an average of 1.2°C by 2030, 1.7°C by 2050 and 3°C by 2100 compared to a pre-2000 baseline (NAPA 2010). It has also mentioned results of another study which states that the mean annual temperature will increase by 1.4°C by 2030, 2.8°C by 2060 and 4.7°C by 2090 following the General and Regional Circulation Models projections.

Himalayan region has experienced both the increasing and decreasing trends of precipitation. The Tibetan Plateau

in the northeast region (Zhao et al. 2004) and eastern and central parts (Xu et al. 2007) has shown the increasing precipitation trend while the decreasing trend was observed in western Tibetan region. Nepal, however, has shown no distinct long term trend in precipitation (Shrestha et al. 2000). Discussing model prediction on precipitation trend, NAPA (2010) has mentioned of precipitation projections which show no change in western and up to 5-10% increase in eastern Nepal for winter. During the summer months precipitations are projected to increase for the whole country in the range of 15 to 20%. The report also discusses a regional circulation model study which projects both rise and decline in the mean annual precipitation with no clear trends. In terms of spatial distribution, this study projects an increase in monsoon rainfall in eastern and central Nepal as compared to western Nepal. Further, the projections indicate an increase in monsoon and post-monsoon rainfall as well as an increase in the intensity of rainfall, and a decrease in winter precipitation. IPCC (2007) has projected that there will be a general increase in the intensity of heavy rainfall events in the future and an overall decrease by up to 15 days in the annual number of rainy days over a large part of South Asia.

The changing trend of temperature and precipitation has made Nepal a climate change hotspot despite the fact that its share of CO₂ emissions is negligible in the global context. This paper first takes stock of the state of climate change impact in each geologic or tectonic units followed by a

synthesis of government's initiatives to combat the negative impact of climate change. It then offers strategic programs required to make climate resilient communities in Nepal.

STATE OF CLIMATE CHANGE IMPACT

Based on the secondary data collected from various sources such as journals, websites and technical reports available at government and non-governmental offices, an analysis was made regarding the types of climate change outcome risk occurring in Nepal (SPCR 2010). The analysis also used unpublished reports on expert group meeting, stake holder meeting, decision-makers meeting, donors meeting related to climate change issues in Nepal. Similarly, information received from government ministry officials, district level bureaucrats, community leaders and independent professionals have also been taken into account as their field-based experiences also reflects the ground

Higher Himalayan and Lesser Himalayan Zones. In addition to GLOF hazards, drying out of springs have caused serious threat to many century-old settlements. National newspapers have reported that some villages in Mustang district have already been displaced due to drying out of drinking water sources. In Lesser Himalaya zone, landslides and drought are major climate induced hazard. Drying out of water sources have caused increased in fallow land leading to mass migration at several villages. The Siwalik zone is seriously affected by landslides, debris flows and soil erosion whereas the Terai region is more prone to flood hazards along with sediment deposition at some places and river bank cutting at other places.

GOVERNMENT INITIATIVES

As already mentioned above, the impact of climate change is not limited to any particular area. It has been felt

Table 1: Major climate change outcome risks in different geologic zones of Nepal Himalaya

Geologic unit	Ecologic units	Major climate change outcome risk
Terai	Terai-Churia Range (includes also Dun Valleys)	Flood, drought, debris flows, river bank cutting, vector and water borne diseases, forest fire and degradation of ecosystems
Lesser Himalayan Zone	Middle Mountain (includes also Mahabharat Range and Midlands)	Landslides, drought, drying out of springs, prevalence of insect and diseases in agriculture, and wildlife migration
Higher Himalayan Zone	High Mountain (includes snow peaks)	Rapid glacial melting, glacial lake outburst flood (GLOF), drying out of springs, wildlife habit degradation, shifting of snow line, landslide and ecosystem degradation
Tibetan Tethys Himalayan Zone		

reality. A synthesis of the reports is incorporated in Table 1.

The High Mountain region, comprised of Higher Himalayan and Tibetan Tethys Himalayan Zone, is vulnerable to rapid glacial melting facilitating for Glacial Lack Outburst Flood (GLOF) among other climate change outcome risks. Nepal has already experienced 10 trans-boundary Glacial Lake Outburst Flood (GLOF) events which actually originated in Tibet and their adverse impacts were also felt in Nepal. For instance, GLOF event of 1981 at the China-Nepal border had caused serious economic losses in Nepal amounting US \$3 million (Bajracharya and Mool 2006). Glaciers within Nepal are also retreating at faster rate suggesting increase in GLOF frequency under climate change scenario (Fujuta et al. 2001). There are twenty one lakes identified within the Himalayan regions (particularly in Tibetan Tethys Zones) as potential dangerous of which six has been identified as critical (MOE 2010) and need urgent investigation (Ives et al. 2010) as well as implementation of hazard reduction measures. If a GLOF initiates in the Tibetan Tethys Zone, its effect will also be felt across the

through out the country covering all the majors' development sectors. To minimize the negative impact and to exploit the opportunities associated with the climate change impact, government has initiated some adaptation initiatives, which are briefly described below.

National Capacity Self Assessment (NCSA)

Using an inclusive consultative process, Nepal completed the NCSA with one of the objectives being to explore related capacity needs within and across the main thematic areas of biodiversity conservation, combating climate change, and land degradation. The NCSA also paid particular attention to those capacity constraints and opportunities that cut across the concerned international Conventions to which Nepal is a signatory. The NCSA revealed: (a) the absence of observation stations to collect key meteorological data (spatial and temporal) needed for the establishment of early warning systems; and (b) the low level of capacity and funding for climate change risk management measures.

National Adaptation Program of Action (NAPA)

As a foundation for receiving supports from international and bilateral agencies to combat against negative impact of climate change, the Government of Nepal has prepared its National Adaptation Programme of Action (NAPA 2010). Initiated through a broad-based consultative process, NAPA process was geared-up by six Thematic Working Groups (TWGs), namely Agriculture and Food Security, Forests and Biodiversity, Water Resources and Energy, Climate Induced Disasters, Public Health, and Urban Settlements and Infrastructure. The work of the NAPA-TWGs resulted with a “long-list” of adaptation options, which were synthesized into nine immediate and urgent project profiles. The total cost to implement urgent and immediate adaptation measures was estimated to be US\$ 350 million. The prioritized adaptation options include both urgent/immediate and long term adaptation strategies in key vulnerable sectors under the six TWGs.

Pilot Project for Climate Resilience (PPCR)

In order to help Nepal transform to a climate resilient development path, consistent with poverty reduction, food security and sustainable development goals, the Strategic Program for Climate Resilient (SPCR), a preparatory phase of PPCR, builds upon government’s ongoing programs to address poverty and support the country’s long-term vision to achieve a climate resilient development by initiating five broad interventions as follows (SPCR 2010):

- (a) Building climate resilience of watersheds in mountain eco-regions;
- (b) Building resilience to climate-related hazards;
- (c) Mainstreaming climate change risk management in development;
- (d) Building climate resilient communities through private sector participation; and
- (e) Enhancing climate resilience of endangered species.

The proposed interventions will be implemented after establishing a comprehensive program of capacity building for climate change risk management at the systemic, institutional and individual levels, at the national, sectoral, district and local level, and within the public sector and civil society that will support the integration of climate change risk management into development planning. The SPCR proposal submitted by Nepal Government has already been approved by PPCR Sub-committee. The total fund available to implement the interventions for Nepal is \$40-\$50 million in grant and \$36 million in other concessional resources.

Climate resilient planning

The Three-Year Interim Plan (TYIP) has a strategy of continuing disaster risk reduction and poverty environment initiatives as a means of promoting climate change adaptation and sustainable natural resource management (NPC 2010). It has also adopted a working strategy of formulating climate resilience friendly plan to implement the NAPA priority projects. It also envisions developing and implementing Early Warning System (EWS) to protect communities and infrastructures from glacial lake outburst floods, floods and

other natural hazards including negative impact of climate change which are priority interventions under the SPCR.

The National Planning Commission (NPC) has recently completed Nepal’s Climate Resilient Three Year National Development Plan. The plan incorporates the anticipated risks, improve climate knowledge, and help create synergy between and among multiple players in infrastructure management and development. The approach taken will help redefine the development issues in order to understand the inter-linkages and reduce climate change impacts more effectively. A climate resilient planning method begins with screening of development plans to determine the extent to which a project might be affected by climate related impacts, and to identify adaptation options to reduce resulting adverse impacts.

STRATEGIC PROGRAMS FOR BUILDING CLIMATE RESILIENT COMMUNITIES

Generally, climate resilience is determined by the degree to which a social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures (IPCC 2001). It means developing a climate resilient community is not a single effort but a cumulative process of assessing vulnerabilities, setting resiliency goals, and developing adaptation strategies.

As already mentioned above, the climate change outcome risks differ in each geological zone and also in each ecological unit. Consequently, the strategic programs required to make communities climate resilient may also differ accordingly as shown in Table 2.

As an initial step to make a community climate resilient, some national level strategies should be initiated first based on the national level vulnerability analysis. It includes concerned government and non-governmental organizations’ capacity enhancement installing sufficient number of required instruments (for example, establishing hydro-meteorological stations in major river watersheds), providing adequate training to human resources, enabling technicians to collect, store, analyze and interpret climate change data, and disseminating the result to public domains for further consideration. Then, strategic activities listed in Table 2 should be implemented after clearly knowing the resiliency goals identified on the basis of vulnerable and vulnerabilities in each geologic zone. The activities may be implemented and monitored taking assistance from various sources including donor agencies. But for long term sustainability of the programs, a perennial source of funding should be assured to make the strategic programs self-financing. Such fund may be collected through government decision such as by imposing Carbon levy (to be imposed to tourist, aviation companies, and cement industries). In addition, integration of climate change risk into development process has also to be initiated as early as possible. The lesson learned from

the implementation and monitoring of the proposed strategic programmes may be useful in this regard. Table 2 shows the recommended strategic programs intended to build climate resilient community in Nepal.

CONCLUSIONS

The major climate change event risks in Nepal are well documented as increase in temperature, extreme high precipitation and extreme low precipitation events. These events have resulted in several climate change outcome risks that include, among others, rapid glacial melting in the Tibetan Tethys zone and wildlife habitat degradation in the Higher Himalayan zone. Similarly, drying out of drinking water sources forms serious climate change induced problem in Lesser Himalaya zone. The Siwalik zone is severely affected by landslide, debris flow and soil erosion whereas the Terai region is more prone to flood hazards along with sediment deposition at some places and river bank cutting at other places. Although these events were noticed in Nepal since many decades, the increasing trend of these outcome risks are directly attributed to the impact of global warming in recent years.

Although the government has initiated some climate change adaptation initiatives, the “business as usual” approach still do prevail in development practices and day to day functioning of the national and local government. To minimize the impact of climate change and to maximize the associated opportunities, several climate resilient activities/strategies should be designed such that they facilitate for climate resilient communities and provide effective solution to the uncertainties in terms of magnitude and timing of climate change impacts in each geologic zones. Accordingly, the recommended strategic programs include monitoring of glacial lakes and establishing of GLOF early warning system in the Tibetan Tethys zone, initiating integrated ecosystem management in the Higher Himalayan zone, initiating integrated water resource management in the Lesser Himalayan zone, implementing effective soil erosion control measures in the Siwaliks zone, and implementation of community-based flood hazard control measures in the Terai region.

The recommended strategic programs are intended to minimize the negative impact and maximize the benefit from the positive impact of climate change. However, as the systematic hydro-meteorological data collection, store and

Table 2: Strategic programs required in each geologic zone to build climate resilient communities in Nepal

<p>Region: Tibetan Tethys zone Strategic Program: Monitoring of glacial lakes and establishing of GLOF early warning system</p> <p>Major activities:</p> <ul style="list-style-type: none"> • Mapping of glacial lakes. • Identifying critical glacial lakes. • Monitoring critical glacial lakes, and implementation of disaster risk reduction measures. • Establishing GLOF early warning systems in downstream vulnerable communities. • Preparing GLOF hazard maps in critical areas and its use in regional planning. • Providing livelihood diversification schemes for effected population. • Promoting high value crop. • Ensuring access to hospitals, schools and market places for each communities.
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<p>Region: Higher Himalayan zone Strategic Program: Initiating integrated ecosystem management</p> <p>Major activities:</p> <ul style="list-style-type: none"> • Preparing a data base and monitoring of water discharge of rivers and springs. • Constructing community water storage facilities. • Preparing landslide hazard maps of critical areas and its use for disaster risk reduction. • Providing access to market places, schools and hospitals to each communities • Conserving endangered species. • Conserving pasture lands and promoting suitable livestock raising practices. • Promoting high altitude crop varieties.

Region: Lesser Himalayan zone

Strategic Program: Initiating integrated water resource management

Major activities:

- Estimating water budget in major watersheds.
- Constructing water storage ponds and promoting rain water harvesting.
- Preparing landslide and flood hazard maps of critical areas and its uses in developing new settlements.
- Monitoring quality, quantity and long term availability of major water bodies including those being used as intake for drinking and irrigation water use.
- Initiating crop diversification schemes along with protection of indigenous seeds of each crop.
- Climate proofing of micro-hydro, strategic roads, irrigation canals, intact structures constructed at vulnerable locations.
- Developing climate resilient satellite cities or economic centers with a provision of accommodating housing requirements for climate change induced immigrants.

Region: Siwaliks

Strategic Program: Implementing effective soil erosion control measures

Major activities:

- Conserving national forest and promoting community forests.
- Initiating forest fire prevention measures.
- Providing preventive and mitigating measures to debris flows and flash floods.
- Preparing landslide, debris flows and flash floods hazard maps of critical areas and their utilization in initiating development activities.
- Preparing land use maps and its use in developing new settlements.
- Identifying a suitable method of terrace development for cultivation in hill slopes.
- Conserving drinking water sources, intake and drinking water supply pipes.
- Preparing technical guidelines to construct linear infrastructures like road and irrigation canal, and also for extracting bed rocks for various purposes.

Region: Terai

Strategic Program: Implementation of community-based flood hazard control measures

Major activities:

- Establishing community based flood early warning system.
- Conserving drinking water sources and providing safe drinking water.
- Providing drought/flood resistant crops to vulnerable communities.
- Constructing emergency shelters to be used by the effected families.
- Providing insurance for crop failure.
- Constructing community cold storage to store food grains and vegetables.
- Providing technology for low cost housing.
- Climate change proofing of major infrastructures.
- Preparing technical guidelines to extract sand and gravel from river beds.

analysis in each watershed level is still in infant stage, the geologic zone wise distribution of climate change outcome risks should be taken as a preliminary guidance while implementing the interventions in the local level. A further in-depth research is in need to identify the most prevalence impact of climate change outcome risks in sub-watershed level and also to design and implement interventions to make a local community climate resilience.

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