Implications of Climate Change on Biodiversity in Nepal: Some Observations and Opportunities

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Now there is no doubt among scientific communities that earth is getting warmer due to greenhouse effects leading to unintended changes in climatic patterns. This paper attempts to address some of the pertinent questions of climate change impacts in Nepal and then emphasizes on efforts required to make community forestry an eligible sector for international climate funds. Importance of the initiative lies on the fact that rural communities of developing nations have a crucial role to restore and manage local forests. Like any other forests, these are the source of numerous environmental services including carbon sequestration, reduced or avoided deforestation/degradation, watershed protection and biodiversity conservation.

To support the arguments, cotemporary literatures and some empirical evidences of climate change impacts in parts of Nepal Himalaya are discussed. Highlighting the preliminary findings of an action research called 'Kyoto: Think global, act local', that shows community forests as a source for carbon sequestration, the paper concludes with an emphasis on promoting international advocacy in favour of making the community forestry activities of Nepal and other developing countries eligible for global climate funds.

Effects of global warming

Effects of global warming encompass all vital systems supporting world populations. Human health, agriculture, forest, water resources and biodiversity will suffer at different scales depending on local conditions. Assessing the effects of global warming with reliable accuracy is very challenging at macro level and almost impossible at micro or local level. It is further difficult task in a country like Nepal where climatic database is comparatively weak in terms of network coverage, duration and quality. Visible changes such as glacier retreat in the Himalaya are well monitored; therefore, it is possible to project future scenarios of water discharge in snow-fed rivers. Case studies on various aspects of climate change impacts are also useful to analysis the situation.

Nepal's Initial National Communication Report on Climate Change to UNFCCC mentions increased seasonal and annual air temperature over the last few decades. Observed annual trend of temperature rise per decade is 0.41_{o} C while seasonal rising trend for temperature during pre-monsoon, monsoon and winter periods are 0.43^{0}C, 0.43^{0}C and 0.37^{0} C per decade respectively (HMG/MOPE 2004). This is much higher

than of global average. Chaulagain (2003) finds that mean temperature in the vicinity of Tsho Rolpa Glacial Lake in Dolakha District is increasing annually by 0.019 degrees Celsius with an increase in average summer temperature of 0.044 degrees Celsius. Further the study shows increase in rainfall by 13mm per year, while the number of rainy days is decreasing by 0.8 days per year suggesting that rainfall occurs in bursts. Consequently, river flow is increasing at 1.48m^3/s per year, which is about 1.5 times higher than increases in precipitation. High increases in summer river flow provide further evidence that high summer temperatures are leading to fast glacial melt.

The rate of glacial retreat reached up to 1.8m per year in the 1970s and 2.4m per year in the 1980s. As a result of fast glacial melt, new glacial lakes have formed and those already existing have grown rapidly. This alarming highland trend threatens downstream communities and the environment due to the increased risk of glacial lake outburst floods. The occasional bursting of glacial lakes in the past has seriously damaged the lives and livelihoods of mountain communities. Such threats operate in conjunction with other changes to the patterns of river flow, spring water recharge, precipitation and vegetation types expected as a result of global warming in the Himalayas.

A case study from Mustang and Manang

Many of the highland residents of Manang in the Annapurna Range of the Himalayas have observed heavy monsoon rains in recent years. This type of erratic monsoon precipitation is a new phenomenon. 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. Decreased winter snowfall could eventually lead to a shortfall in the village water supply.

Some farmers in Mustang, the neighbouring 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.

Table 1: Perceptions of Climate Change at communities level

Parameters		Impacts
Climate and hazards	Temperatures and wind	Winter is less cold and frosty, The river valleys of Kali Gandaki are getting windier.

	Precipitation	Less amount of snowfall in winter. Increased rain and snowfall in post winter; Unusually intense rainfalls in summer,
	Weather hazards	Increased frequency of avalanche, flash floods, windstorms and hailstorms; Rainfall pattern getting more erratic (long drought and sudden heavy rains etc), and Increased losses of lives and property due to harsh weather incidents.
Vegetation	Tree line	Increase altitude of tree line
	Grasslands	Less greenery in grasslands. Less snow deposits a major reason for moisture deficiency and less grass production.
Water supply housing	Water supply	Reduced flow in local streams and springs. Unpredictably high fluctuation in flow levels and timing for recharging seasonal spring
	Housing	Increased cases of roof leakage and wall erosion in traditional mud-build houses. Water supply a major problem behind the ruining and abandonment of some old settlements in Mustang.
Agriculture	Apple farming	Bigger and tasty apples at even at higher altitudes where climate used to be too cold for farming the apples. Emerging apple orchards and nursery farms.
	Vegetable farming	Successful farming of cabbage, cauliflower, cucumber, chilly and tomato in open garden (without green house).
Lifestyle/ business		Elder people find their villages more comfortable due to less chilly winter. Tourism business more profitable due to longer period of drought in post monsoon months. Agricultural businesses suffer loss due to irrigation and variation in precipitation pattern.

Dahal, 2005.

The vulnerability of mountain dwellers is likely to increase due to changes in rainfall patterns. Increased water-related hazards and a shift in the rainy season will affect household incomes, most of which depend on subsistence farming. Health effects could include the extension of ranges of vector borne diseases such as malaria and encephalitis to mountain settlements. Progress in environmental management has been slow and natural resource degradation remains at the core of many problems. Climate change will add a new stress to ecosystems and socioeconomic systems already affected by poverty, natural resources depletion and unsustainable management practices. Climate change impacts on land resources will make management even more difficult if appropriate measures are not taken.

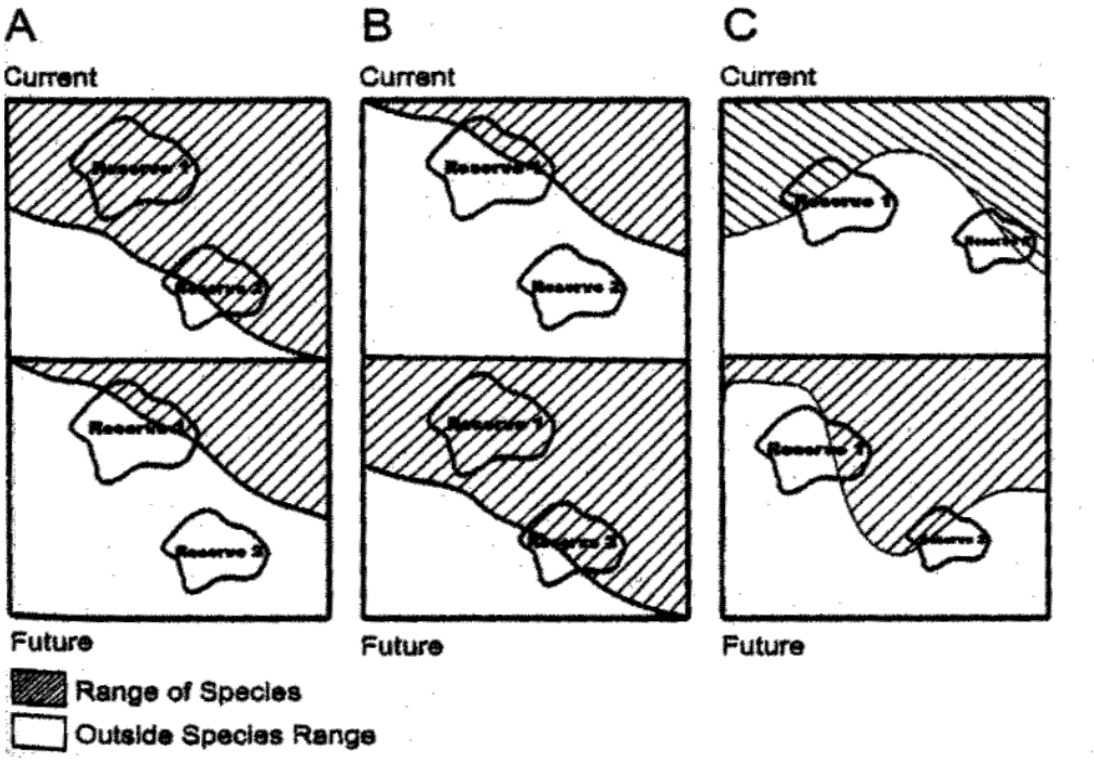
Uncertainty and emerging challenges to ecosystem management

Uncertainties associated with climate change are immense because of complex effects on all aspects of biosphere. Understanding the real nature of climate change effects may take years though some spectacular effects such as melting of glacier are already noticed. Inadequate research database and analysis is evident. The projected scenarios are available but at global or regional scale. The smaller the scale of the projection, the poorer is the accuracy. All these issues make the projections of future scenario more complex and difficult to isolate the effects from regular effects. However micro scale

analysis is essential to take remedial action locally. These uncertainties have clear implications on planning and management of protected areas.

Possibility of wider gaps in protected area management is one of the projected impacts of climate change in ecosystem management. The nature of impacts however is complex because of each ecosystem component is interlinked. Some key components include shift of species range, ecosystem resilience and connectivity, topography, extinction risk, sea-level change, landscape ecology, montane geography & disturbance regime.

Peters (1991) pointed out that climate change could alter the relationship between a species range and reserve boundaries as depicted in the figure. Decrease in range within the reserve/becoming absent where previously present (A), increase in range within the reserve/becoming present where previously absent (B), and change in location of range (C).



In general range migrations are expected towards higher latitudes and higher elevations. At a specific reserve, range shifts may result in three types of effects for a particular species (Hannah and Salm, 2003). Management of species whose range or population is declining within a reserve may be warranted, depending on their global or regional conservation status and their abundance within the reserve. For species whose ranges are expanding within a reserve it is important to plan for the impact of this expansion on other species with the area.

This type of projections has clear implications to Nepal as well for her one of the richest bio-diversity and unique geographical position in the world. With 5833 species of flowering plants, including about 248 species of endemic plant and 700 species of

medicinal plants, Nepal's landmass is home to 26 species of mammals, 9 species of birds and 3 species of reptiles that are declared endangered and are being protected by Nepalese laws (HMG/MOPE, 2001).

Opportunities

Growing concern of developed countries on climate change related problems have triggered interests of planners and researchers to focus their research activities on the potential challenges and problems through multiple disciplines. The Himalaya is considered as a barometer for monitoring effects of global warming. Because of the unique geographic diversity within a short span, Nepal can attract the researchers to conduct climate change related research activities while allowing Nepali researchers and planners to play the active roles. The researchers could be useful to plan adaptation and mitigation activities.

Also, Nepal, being a least developed country, can learn from others to replicate good practices through the access of global climate funds for sustainable technologies. 'Think global, act local' concept will be useful to access the global climate funds for biodiversity conservation, promotion of clean energy technologies, and poverty reduction. Use of climate change information in project planning and development (to enhance resilience capacity of community and development infrastructures), capacity building of national and local institutions and upgrading negotiation skills, planning and implementing innovative research and development schemes are the other avenues to tap the opportunities.

Compensating community forest for carbon sequestration service

Nepal's community forest management approach has been widely acknowledged for its successful cases of community forestry management programmes, as they have been effective in increasing biomass, sequestrating carbon, supplying fodder and fuelwood supplies, helping to reduce poverty, enhance livelihoods, promoting participatory local governance, and supporting local initiatives. Unfortunately the current policy of Clean Development Mechanism (CDM) expounded by Kyoto Protocol is silent on the contribution of community forest, thus, requiring lobbying to make a decision in favour of using the international climate funds to compensate the enhanced carbon sequestration service. Success stories on the revival of once degraded Himalayan forests imply that community forestry has offered an effective and sustainable approach for offsetting carbon provided communities enjoy the benefits of resource conservation. Carbon management could be converted into an opportunity to add value to their work as it provides communities with powerful incentives to manage local forest more effectively.

As an effort to initiate the process of international policy change in favour of carbon function of community forest, National Trust for Nature Conservation (NTNC) is undertaking an action research in Nepal in partnership with University Of Twente of Netherlands and ICIMOD. The research project called "Kyoto: Think Global, act local" aims to generate support for community forestry activities of developing countries as

eligible projects for the compensation. The research involves a range of activities including assessment of carbon sequestration rate at designated research plots, possibility of empowering local community to monitor and report carbon stocks and exploring of markets for carbon transaction (both voluntary and CDM based) among others.

The research hypotheses are that community forests generate additional carbon compared to earlier management regime, the deforestation or degradation rates reduced, even a small payment for carbon services to local communities helps encourage them to practice sustainable management. The efforts are gaining momentum in recent years and voluntary buyers are emerging to buy the sequestered carbon.

Preliminary analysis of data shows carbon growth is approximately 2 ton per hector per year. Growth is highest in Ilam (2.94 ton/ha-yr) followed by Manang (1.65 ton/ha-yr) and Lalitpur (1.30 ton/ha-yr). Research sites of Ilam and Lalitpur fall in extensively used forests while it is restricted in Manang. Growth of carbon stocks is mainly due to better management of communities, indicated by socio-economic survey among users households (NTNC, 2006).

Currently Nepal government has handed over nearly 1.2 million ha for community management. With 2 tons per ha per year growth, the CF sector can generates 2.4 million tons of carbon in a year. Current international market price of 1 ton carbon ranges from $ 5 to $20. With $ 5 per ton, there is a prospect of Nepal CF sector earning US $12 million annually. However there are some major hurdles to overcome, namely, eligibility of CF for CDM, transaction costs, capacity to develop the projects and negotiate with buyers etc

Current research, therefore, aimed partly at the international policy process; with a view to influence to ensure that CF for sustainability is included in CDM after the first commitment period of Kyoto i.e. after 2012. The research will produce the much required data and technical guidelines for carbon survey at community level but needs further actions at government level to further the advocacy. Initiative from government agencies is crucial to further the international lobby in favour of bringing CF into Kyoto Protocol

Conclusions and ways forward

Climate change is imminent threat to global environment and Nepal is one of the most vulnerable counties to face the negative consequences of its effects. Indeed, Nepal has already been suffering from climate change-led impacts such as depletion of snow cover, glacier retreat and glacial lake out-burst flood. At community level, problems like erratic rainfall patterns, water hazards, water shortage and vector borne diseases are reported to be growing. Early flowering and ripening of fruits or cops and shifting seasonal weather patterns other changes reported at local level requiring to be validated by a comprehensive scientific study. However, there is lack of information about the impacts of climate change on behavior of wildlife species, range of habitat and food, migration and incidents of epidemic diseases among others. This type of information is vital for planning wildlife and biodiversity conservation activities and implementing adaptive measures to cope with the challenges.

How to cope with the imminent threat of climate change is the new focus of the global discourse. Obviously empowering communities with information, technological skills, education and employment is the answer for the question, but this is difficult for the resource poor developing countries like Nepal. Mobilization of global funds to compensate exemplary works in conservation through a flexible market based mechanism like the one expounded by Kyoto Protocol's Clean Development Mechanism is a window of opportunity could be tapped if the contribution of local communities such as of community forestry practices were made eligible for utilizing climate funds. Partnership building in global policy research initiatives such as 'Kyoto: Think global, act local', which is being implemented by National Trust for Nature Conservation in Nepal would be the first step to the long march for future. Therefore awareness raising and enabling activities for capacity building at national to local level is crucial not to miss the opportunity of tying global policy with local conservation and development activities through global climate funds.

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