Living with uncertainty: climate change and disasters

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1. Introduction

A study, using participatory vulnerability assessment tools, was carried out in *Kadampur*, and *Mirtung* villages on the bank of the *Baulaha Khola* in Nawalparasi District in central inner Tarai, Nepal. Enquiries were based on a checklist prepared in advance and secondary information from other areas in the vicinity was incorporated. The study was able to accumulate information on changes, impacts and adaptations that have occurred over the past 40 years. Existing literature on climate change, its impacts, vulnerabilities and adaptation support the collected information.

The area lies on the Tarai belt just south of the Siwalik Hills, the youngest and geologically most fragile of the Himalayan ranges ; vulnerable to any sort of environmental changes and hazards.

Irrigation on the Tarai is dependent on the upper catchments (which fall in the Siwaliks) for water resources in the form of stream flow and the recharging of underground aquifers. At the same time, the region is susceptible to flash floods that destroy lives and livelihood assets. These are increasing in frequency and magnitude.

Migration to the area from the mountains started some 45 years ago after the reduction of malaria. Before this the Tarai was covered with dense climax vegetation with few very confined settlements of indigenous people resistant to Malaria. The rich biodiversity of the past has been supplanted by a dense and diverse human population. With increasing human population and the resultant degradation of ecosystem health both in the Siwalik and the Tarai, this narrow belt is now witnessing a scarcity of available water, an increasing frequency of disasters, particularly flash floods, and a rise in conflicts over shared resources. It is generally agreed that impacts of climate change further worsen such consequences. This article discusses how vulnerabilities to disasters are changing in the study area in the context of changing climate and how people are responding to the impacts of these changes.

2. Methodology

This study was carried out using participatory methodologies based on community risk assessment (CRA). CRA encourages the participating community to understand the underlying causes of their vulnerabilities and to identify their existing capacities and local coping strategies. This enables researchers to understand local issues of disasters, vulnerability and existing coping measures. This section explains the tools, techniques and processes employed in the study.

Existing secondary information documented evidence of past flood damage to agricultural land and complaints of water deficit for irrigation as key contributors to insecurity. A preliminary visit revealed the need for an in-depth study of the causes and effects of prevailing hazards, their frequency and intensity together with trends over time. A checklist of the required information was developed with the help of an expert on participatory vulnerability analysis. Besides general information on geographic location, analysis focused on the types of hazards experienced, both past and present, their frequency, intensity and trends over time. Livelihood strategies and the assets employed were examined along with people's perceptions of risk and understanding of vulnerability. Information on the existing strategies employed by communities to reduce their vulnerability was collected.

Key informants were identified through random discussions with local people in each hamlet. Long-time residents of the area, victims of previous hazardous events, people involved in river bank protection, irrigation management and other social works were singled out for questioning. Each key informant was visited and interviewed separately regarding their knowledge and experience of local hazards. Larger settlement-based group discussions were organized. All findings were verified by triangulation. The discussions indicated that different people were vulnerable to different disasters such as flood, drought and winter fog. Individuals vulnerable to similar hazards were then regrouped for in-depth investigation of their vulnerabilities, their underlying causes and their consequences.

In addition to semi-structured interviews and focused discussions, participatory tools such as historical timelines and time trends of major hazards were employed. Perceived community explanations and contributory factors to observed trends, such as weather patterns and socio-economic activities in the area over time were assessed and analyzed in group discussions. Hazard mapping, seasonal calendars of crops and their vulnerability to different hazards, cause and effect analysis (problem tree) and story telling provided rich sources of information which contributed to an understanding of prevailing vulnerability.

Information from each group was triangulated in the successive discussions. The Author and his team members facilitated the meetings and recorded the findings. Each physical area mentioned by either group or key informants was visited and observed with community members. The team was able to build a picture of how the prevailing conditions had come into existence, what had changed over time with respect to both the hazards and the community's ability to respond to the hazards.

Available information in each step was documented in the form of notes, figures and pictures as appropriate. The information was then rearranged including relevant secondary information. The summaries of findings are described in the sections hereafter.

3. Findings and analysis

3.1 Local climate and changes

The climate in the study area is sub-tropical monsoon with a mean annual temperature range between 23^0C and 25^0C. This average has increased by 1.3^0C during the last 30 years (2005 figures). Average annual precipitation for the same period ranged between 1500 and 2500 mm; an increase of 614 mm since 1976. (Information recorded in Dumkauli station adjacent to the study area by Narayani Basin office of Department of Hydrology and Meteorology). More than 80% of this rainfall is received between mid June and mid September. The remaining 20% is scattered over the rest of the year. Prior to intensive immigration from the hills and mountains of the last 45 years, the area was dense forest with confined settlements.

The studied communities have experienced and are aware that weather patterns are changing over time. They identified changes in the nature of rainfall, temperature increases, winter fog, windstorms, hailstorms and frequencies of disasters like landslides, floods and droughts. They are acutely aware of meteorological changes that bring about either adverse or favourable conditions to their livelihoods and assets. Individual understanding differs according to the exposure of the respondent and their family to different hazards and impacts caused by these changes. While many respondents have undertaken adaptation measures to cope with changing

circumstances, their success or failure is dependent upon both the magnitude of the impacts and the resilience capacity of the victims to such changes.

While heat, winter fog, floods and droughts are said to have increased in frequency and intensity, there is great variability in occurrence. Summers are getting hotter, winter fog, locally known as *Sheet Lahar*,[1] has increased, noticeably over the last 20 years. This prevents sunlight from reaching the land surface causing the temperature to remain low throughout the day. While some experts regard this as being the result of global temperature rise and atmospheric pollution, the people perceive that winters are getting colder which is very likely due to constant low temperature throughout the day.

The most commonly noticed change is rainfall which directly impacts on agricultural practices. While meteorological data shows an increase in annual precipitation, the pattern of rainfall has become more erratic. More rain is falling in a shorter period (increased intensity) with often longer gaps between rain events. This disturbs the recharge and discharge of catchments and increases overland flow, landslides and flash flooding. Socioeconomic activities like deforestation, shifting cultivation on hill slopes, over grazing, unplanned settlements, construction of roads and other infrastructures without mitigation measures all contribute to intensifying landslide and flood hazards and the frequency of disastrous events.

The landscape and objects found while digging tube wells suggest that huge floods occurred in the remote past. Pottery, a set of grinding stones, and most interestingly a tree stump about 30 feet below the surface have been unearthed while digging wells. Current settlements were initiated during the 1960s after clearing natural subtropical climax vegetation. These artefacts suggest that there must have been human settlements in the past that were destroyed by huge floods some 5 to 6 centuries ago. Many local people perceive current flood disasters trends as part of “reincarnation”.

Drought, the lack of sufficient water available for irrigation and domestic use, is increasingly problematic, particularly during the non-monsoon season between October and June. The main stream of the *Baulaha Khola* dries soon after the end of the monsoon and spring water is not sufficient to satisfy domestic demand. Even during the monsoon, the period between two successive rainfalls is increasing. This creates water-stress for crops. The trend of uncertainty is increasing.

Frequency and magnitude of both dry windstorms and hailstorms has decreased in this area. Old people recalled that in the past there used to be strong windstorms and damaging hail stones between March and August. In recent decades they are less noticeable; people say there has been ‘retirement of winds’. A few respondents suggested that this could be due to the lack of forests in the vicinity; others suppose it is due to a shift of wind flow. ‘They must have gone somewhere’, a group suggested. In an earlier study, both windstorms and hailstorms were found to have increased in frequency in *Jugedi* stream watershed. *Jugedi* lies about 20 KM north-east from this area at a slightly higher altitude.

3.2 Hazards and Impacts

Besides “retirement of winds”, the observed impacts of changing weather are adverse, impacting negatively on existing livelihood practices. Despite numerous socio-economic changes over time, no positive impacts were attributed to climate change. While traditionally cultivated local varieties of agricultural crops have been replaced by new species and varieties, this is not

[1] Thick fog which remains for the whole day during winter particularly during January –February.

necessarily due to climate change. Settlement has increased and the construction of houses has changed. Earlier, houses were made with a thatched roof, mud and stone walls with wood pillars and beams. Now almost all houses have either concrete or zinc plated roofs and cemented walls. The advancement of technology and development has helped to increase coping capacity and resilience. Therefore, only 'net impact' could be discussed.

30 year ago Til Prasad Pathak (65 yrs), a resident of *Kadampur* could easily walk bare-foot without an umbrella while grazing his cattle during the summer. Now, he observes, nobody is able to do so; it is simply too hot. Besides, there are socio-economic and technological changes which help people to cope with. This illustrates how increased summer temperature adversely affects the mobility and working time of the people, who are not well-equiped. The poor and less equipped suffer most as they have to walk bare-foot and work all the day in the open to earn their living. Increased temperature accelerates evapo-transpiration and enhances drought. Casualties due to heat stress (*Loo* as it said) were not reported but other illnesses due to excessive heat are commonly experienced. However, better hygiene awareness and improved medical facilities have largely mitigated the impact of rising temperatures on health.

Farmers rebuilding the intake of irrigation channel after the cessation of rain.
Photo: Tek Sapkota/Practical Action

Between June and August flash flood is a major hazard to the livelihoods of local people. Floods damage irrigation channels, foot trails, arable land, crops, settlements and other properties. In recent decades they have become almost annual events. Historical time trend analyses in different villages reveal that over the past 40 years the frequencies of landslides and floods in both upstream and downstream communities has increased. In spite of measures taken in recent decades to prevent and reduce losses, the damage suffered has increased in severity and frequency. In 2006 a torrent claimed 2 human lives and destroyed several houses; while four families had to evacuate their homes in 2007. Flooding has secondary impacts such as spreading diseases, and introducing difficulties in accessing services. While floods can be exacerbated by weak geological structure and socio-economic activities such as shifting cultivation, excessive grazing and unplanned infrastructure development in the watershed, communities clearly link erratic patterns of rainfall to climate change.

Drought was prominent between the months of March and May but this threat now remains throughout the year as the rainfall frequency and pattern has changed in terms of temporal and geographic distribution. Drought has an adverse impact on crop production, preventing timely sowing of seeds, transplantation of seedlings and their care.

In the past, fire was a regular occurrence, but people now perceive that the risk of fire has decreased with the cessation of windstorms. A similar response was found in earlier investigations in Meghauli about 15 KM east. Windstorms used to cause dust-borne diseases such as eye infections. These are now rarer. It is possible that changes in the structure of houses and improved hygiene have contributed to this improvement. Respondents were of the opinion that the decrease in hailstones has a negative effect. They believe that hail stones lower the soil and surface

temperature and increase soil moisture in the hot season. They agreed that would be better if it rained instead but as it does not rain either, the absence of hail contributes to the drought. It is interesting that both have become increasing hazards in Jugedi about 20 KM north-east (Box 1).

Box 1 Largest hailstone

Hukum Singh Gurung (59), a resident of Khetbari village in neighbouring district -Chitwan, had managed his vegetable farm with drip irrigation system to cope with the limited water resources available. In April 2007, there was huge hail storm in the village. His drip irrigation pipe was totally broken along with damage to his zinc plate roof. "I had never seen such big and damaging hail stones before" he exclaimed with sadness in his face. Apart from the cost of repairing his pipe (about $ 31), he lost his whole crop of vegetables that would have given him about $ 300 – his family budget for more than six months! The story is repeated by all the farmers in the area. "It's of no use how favourable other factors are on other days; a single event is enough to cause a great loss within a short time", says Janga Sarki (45). In the earlier week there was a dry wind storm which uprooted hundreds of trees in their community forest. There were only two rainfall events between October 2007 and February 2008; one in January and another in February. Both brought hailstones and damaged winter vegetables tremendously. "I had never seen such a big heap of hailstones before" said Sher Bahadur Tamang (50) of Bhotedhap village.

Extensive winter fog has an adverse impact on human and animal health and causes disease to winter crops. People have not so far witnessed deaths due to *sheet lahar* in their community but have heard of deaths in other parts of Nepal and India. Several incidents of human and cattle deaths have been reported in recent years in northern India and the *Tarai* region of Nepal. Growing winter crops like oil mustard and potato has almost ceased due to the fog which also affects the ability to work outdoors.

4. Coping and Adaptive livelihoods

4.1 Coping through adaptive livelihoods

Communities are not static and have developed strategies to cope with changing and uncertain circumstances. A reservoir has been constructed to collect stream water through a channel for use during the dry season. A system has been established to irrigate fields turn by turn. As the amount of available water is unable to meet the demand, it is utilized only for paddy nurseries which need to be established early, before the onset of the rainy season. At other times the water is utilized in kitchen gardens and for cattle. Most of the land is still left fallow during the dry season. Tube wells provide a possible solution to water shortage, but are costly and not always possible.

Many channels have been constructed across the stream to catch and canalize stream flow during the monsoon for irrigation of rice. To prevent sand accumulation, which can be a problem with this sort of irrigation, sand barriers are built at different points in the channel. Intakes for such channels are temporary and are destroyed in advance if there is a possibility of a big flood in the stream. Decisions to close the intakes are based on the observation of clouds and the arrival of rain in the hills of upstream catchments. Planned destruction of the intakes prevents flood waters from inundating the farm land and settlements, and ensures the remaining sections of the irrigation system are kept intact. Visually monitoring the rainfall in the hills is only effective in the daytime. Flash floods at night remain very damaging.

Communities have constructed flood barriers along the banks of the stream to protect the edge and deflect the eroding current. Throughout the year the poor collect stones, gravel and sand from the

stream, which they sell. This provides a small income and helps to deepen the stream bed. The debris of the next flood is deposited and again collected thus maintaining the flow of the river.

Traditionally people alter their working hours to cope with rising temperatures; working outside in the morning and evening and take a rest or doing indoor tasks during the mid-day heat. This depends upon individuals' nature and place of work. Coping mechanism to untimely and excessive rainfall include adaptation through preparedness, altering planting and harvesting time and so forth. Such measures mature after several trial and error experiments; making mistakes and learning. The challenge of climate change is the uncertainty of the scale, timing and intensity of future change and its consequences.

4.2 Benefit sharing

The extraction of stone, gravel and sand deposited as debris in the stream bed has been a source of income for poor families in downstream areas of the watershed. As mentioned above, this practice has not only provided a source of income for poor families, but has also helped to maintain the depth of the river bed, reducing the risk of flooding. Subject to only one rule: collection should only be made from the main course of the stream leaving the banks intact; the practice was allowed to continue.

Since 1990 the District Development Committee (DDC) has issued licences to large scale contractors to collect these materials. This has reduced the availability of this source of income to the local poor in three ways. Firstly, access to available material has been reduced due to mechanized extraction by large contractors; secondly, the access of small scale collectors to purchasers has been reduced due to large scale extraction in the area; and thirdly, although local people can still collect individually as before, their buyer has now to pay tax which either increases the price he charges the final purchaser or he pays the collector less to offset his costs. The communities receive no benefits from the tax revenue from gravel sales which goes directly to the District Government. This caused conflict between the communities and the District Government.

Aggrieved community members feel that they bear hardships while the government benefits. During discussions one of the participants drew attention to injustice with a satirical reference to the longstanding practice in society in which a mother gives birth, but her husband is congratulated with vermilion powder and flower garlands. Having identified the sources of gravel and sand in the stream, the Community and local political leaders discussed options for an equitable sharing of the resource. The communities wanted the tax revenue to be utilized locally to reduce the risk of disasters created by the stream. In 1993, following protracted discussions and negotiations with village level governments bordering the streams, all the downstream communities united to negotiate with the district government, demanding that the locally generated revenue should be spent locally. Lengthy negotiations have so far yielded few results.

The Local Governance Act of 1995 gave more power to local government and communities and encouraged more lobbying at the District Government Council. Frequent delegations, protests and strong support from local government forced the District Development Committee (DDC) to agree a mechanism for sharing the revenue collected from the stream. 90% of the revenue (50% in cash and 40% in material support such as gabion wire boxes, technical inputs, including administrative and monitoring expenses accrued by the DDC) was allocated for the protection of the stream bank. Part of the cash is invested in stream bank protection while the rest is invested in development initiatives in the stream-bank villages. The group of communities has developed

a charter and registered with the district administration office as a community based organization (CBO). The struggle between the communities and the district government is on-going. The communities want to collect the revenue themselves through their CBO, but the district government is not willing to relinquish their hold on this revenue.

To date, the sharing mechanism has not made much difference to the poor. Influential and economically stronger community members are able to invest in the gravel and sand extraction business, depriving the poor of access to the resource. In addition, their influence ensures that river bank protection and other development activities work in their favour. The voices of the poor are not heard; they are deprived of benefits. Actions which create opportunities for the poor are necessary.

4.3 External efforts

Nepal was one of the first countries in South Asia to draft a Disaster Management Act. This focused largely on preparedness and response. An amended act is currently being drafted which adopts a decentralised approach and acknowledges the essential role of local mitigation activities in disaster risk reduction. The act includes the provision of local (District) disaster management units with linkages to Village Development Committees (VDCs). Currently, Chitwan is the only District that has included DRR in VDC plans. A DRR component is currently being developed for inclusion in the Chitwan District Development Plan. The new act apparently recognizes a livelihood centred approach to disaster risk reduction and adaptation to the impacts of climate change. National policies and acts are adopting a decentralised approach which favours local self governance, though the implementation at local levels is not yet proven. The right of CBOs to manage local resources is not yet recognised. A lot of work needs to be done to bring the benefit of these policies to the local poor who face the hazards.

Local NGOs and civil society organizations are helping deprived communities to speak up on the issues of resource sharing. As the issue of resource sharing is dependant on both formal and informal factors such as position, strength and the potential influencing role of particular factions on decision making and policy implementation, it might take time for the poor to receive an equitable share of the resources to which they are entitled.

5. Conclusion

The impacts of climate change are not uniform - even within short distances. Furthermore the impact of similar changes is different when they interact with other factors on the ground. Therefore, different strategies may be necessary to cope with the same change. A single event which is disastrous to a particular family or group may not be equally important to another. It depends on their specific vulnerability. Triangulation of information and iterative discussions are necessary to identify root causes and end results more precisely. Local people can provide good evidence of the past particularly where systematic observations were not possible.

Climate change has brought adverse consequences to the livelihoods of the community affecting different assets. Disasters are not new nor the result of a single factor, but, as science tells us, human kind is significantly responsible for many of the causative factors. Communities are responding to events but their response would be more effective if the causative factors are addressed. Communities do not have the resources or technologies to address unpredicted and unforeseen consequences of climate change. In short, they lack adaptive capacity.

Local, national and international efforts are essential. A looming challenge is how to cope with both predicted and unknown adversities. We know that climate change is happening, but exactly what this means and what the consequences will be is largely unknown. Much focus has been given to changing policies and suggested pathways are based on the desk analysis of secondary information. The issue for vulnerable communities is how to continue to exist among uncertainty. Strategies to reduce vulnerabilities and increase resilience and adaptive capacity are important components of poverty reduction and when integrated with disaster risk reduction methodologies provide a mechanism for ensuring livelihoods and justice for the innocent victims of climate induced disasters.

Acknowledgements

Thanks are due to community members in Kadampur and Mirtung for providing primary information and sharing experiences, events and situations. Ratna Sapkota of SAHAMATI helped to organize meetings and interactions. Sincere gratitude goes to Pieter Van Den Ende of Practical Action for his help to edit the text.

May, 2008

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