

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 Siwalik hills, the youngest among Himalayan ranges and most fragile geologically and thus much vulnerable to any sort of environmental changes and hazards.

The Tarai is dependent on the upper catchments (which fall in the Siwaliks) for water resources in the form of stream flow and recharging of underground aquifers which is utilized for irrigation. On the other hand, the region has to face hazards of flash flood that destroy lives and assets of livelihoods and now they are increasing both in frequency and magnitude. People started to migrate to this area from mountains some 45 years ago after reduction of malaria. Before that it was covered with dense climax vegetation with very confined settlements of indigenous people resistant to Malaria. The Tarai used to be very rich in biodiversity in the past and now is very densely populated with diverse group of people. With increasing human population and degradation of ecosystem health both in the Siwalik and the Tarai, this narrow belt is now witnessing scarcity of water, increasing trend of disasters particularly flash floods and conflicts on resource sharing. 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. Findings and analysis

2.1 Local climate and changes

The climate in the study area is sub-tropical monsoon with a mean annual temperature range between 23⁰C and 25⁰C. This average has increased by 1.3⁰C 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. 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

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

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 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-equipped. 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.

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 Meghauri 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 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

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.

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.

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