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Disaster Risks and Community Response: A Case Study from Ilam, Nepal †

Pratima Poudel

Himalayan College of Agricultural Sciences and Technology (HICAST), Purbanchal University, Pushpalal Chowk, Biratnagar 56600, Nepal; poudelprati@gmail.com

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Abstract: A field study was conducted in six Village Development Committees (VDCs) of Ilam district to identify common disasters linked with climate change and people's response mechanisms to those disasters in farming communities. Altogether 300 randomly selected households facing different disaster problems were interviewed using structured and semi-structured questionnaire, which was supplemented by direct observation, time line analysis, key informant interview and focus group discussion. In addition, secondary data was collected from District Agriculture Development Office (DADO), Ilam, Central Bureau of Statistics (CBS) and Nepal Red Cross Society (NRCS) Ilam. Farmers' perceptions and reviewed literature revealed that flood, landslide, drought, insect pests, hailstorm, and fire comprise major disaster risk, and they have been affecting agriculture, livelihood, physical infrastructure, and properties for years. It was found that different types of loss such as, landslides has following risks and impacts: wash away of land (45% families) and crops (90%), property loss (10%), loss of physical resources (50%), effects on water resources (69%), loss of livestock (5%), forest degradation (72%) and loss of human live (3%), risks and impacts of flood, drought and fire have also been presented in this study. It was also unraveled that local communities adopt different mitigation measures for different disasters including afforestation, check dam construction, awareness creation, contour farming, relocation, shed reconstruction, construction of plastic ponds, and conservation of local varieties (different frequencies for different measures). Social network has played important role in mitigating disaster risks. People get help from government (38% families) and non-government (50% families) organizations, friends (22%), neighbors (44%) and relatives (20%) in the forms of loan (18%), helping hands or physical support (77%), information (62%) and basic need materials (48%) to manage or respond disaster risks. The paper suggests that local mitigation measures need to be supplemented by more sustainable solutions to make the efforts sustainable, which requires local level integrated planning and coordinated efforts.

Keywords: disaster risk reduction; agriculture; livelihood resources; adaptation; sustainable development

1. Introduction

Nepal is prone to a variety of recurring natural disasters such as floods, landslides, snow avalanches, Glacial Lake Outburst Floods (GLOF), hailstorms, thunderstorms, cold waves, hot waves, drought, epidemics and earthquake. Out of the 75 districts in the country, 49 are prone to floods and/or landslides, 23 to wildfires, and one to windstorms. A total of 64 out of 75 districts are prone to disasters of some type (MOHA, 2009). According to the Natural Disaster (Relief), 1982, natural disaster means earthquake, fire, flood, landslide, heavy rain, drought, famine, epidemic, and other similar natural disaster. It includes the industrial accident or accident caused by the explosions or

poisoning and any other kinds of disaster. According to Action Aid Position Paper, any situation where there is an exceptional and widespread threat to life and the subsistence, which is beyond the coping capacity of individuals and/ or community is to be considered as an emergency and disaster. There is significant convergence between the problems that disaster risk reduction and climate change adaptation seek to address.

As shown in Figure 1, populations already exposed to climate-related hazards and effects will be at greater risk due to a projected increase in the frequency and/or intensity of those hazards and effects as a result of global climate change.

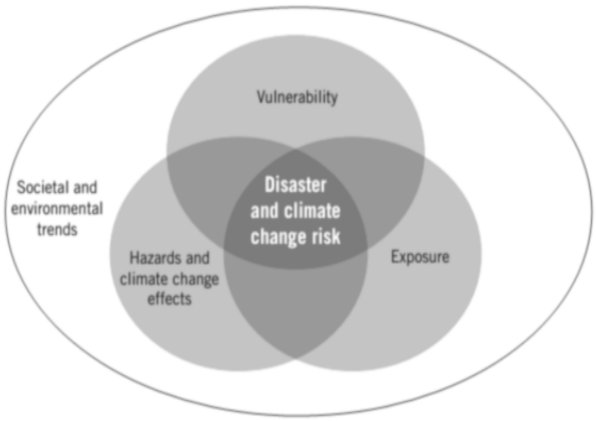

Figure 1. Disaster and climate change risk (Source: Toward Resilience: A Guide to Disaster Risk Reduction and Climate Change Adaptation).

Furthermore, populations exposed to hazards may experience stresses due to longer-term changes in the climate—such as changes in seasonality, unpredictable rainfall, and sea-level rise—that affect their livelihoods and health, making them more vulnerable to all types of shocks, events and further changes. Disaster risk reduction and climate change adaptation also share a common conceptual understanding of the components of risk and the processes of building resilience. The two approaches regard risk as the product of exposure and vulnerability, either to hazard(s) or effect(s) of climate change, or both. The greater the vulnerability, exposure and magnitude or likelihood of the hazard/climate change effect, the greater the risk. Both exposure and vulnerability are compounded by other societal and environmental trends, e.g., urbanization, environmental degradation, and the globalization of markets. Thus, to reduce disaster and climate change risk, exposure needs to be minimized, vulnerability reduced, and capacities for resilience strengthened in ways that address both disaster and climate change risk simultaneously, neither approach compromising the other.

From this study we could know the major disasters occur in the Ilam district as well as we have documented indigenous knowledge by the community to respond and disaster risk.

2. Materials and Methods

Research was carried out on farmers, residing around the Ilam Municipality with associated disaster prone area, were the target population for the study. Especially residents on the 6 VDC's of Ilam District Nepal i.e., Kanyam, Chulachuli, Bhanjyang, Godhak, Namsaling and Sangrumba. Altogether 300 respondents were selected by applying simple random sampling method with multiple responses.

Both primary and secondary data were collected and analyzed. Primary data were collected through by using different Participatory Rural Appraisal tools as focus group discussion, key informant's interview, transect walk, timeline, and community consultation. Furthermore, the household survey using structured and semi-structured questionnaires helped to gather detailed information where 50 farmers from each village above 30 were the main respondents having 10 years'

experience on facing these natural hazards. The study is based on farmers' perception, effects of disasters and the methodologies they applied to cope the situation. Whereas secondary information were collected from the various publications like journals, research articles, proceedings of various Non-Governmental Organizations (NGOs) and International Non-Governmental Organizations (INGOs), reports of District Agriculture Development Office (DADO), District Development Committee (DDC), Nepal Agricultural Research Council (NARC), Central Bureau of Statistics (CBS), Ministry of Agriculture and Cooperatives, and Department of Hydrology and Meteorology. Data analysis was done using a SPSS and MS Excel.

3. Result and Discussion

3.1. Change in the Climatic Condition

Increasing trend of temperature rise and precipitation extremes have been observed in Nepal along with the incidences of heavy precipitation at many cases that ultimately leads to the disaster. Compared to past 10 -15 years, the climatic condition has been changed. Summer temperature is getting hotter and the period of summer season has also increased accordingly. Almost all people felt that, it has become more difficult for them to tolerate solar radiation nowadays than previous 10-15 years. As well as change in the pattern of rainfall, drought, fog and in the hailstone is being increased or decreased.

Regarding the matter of winter temperature, respondents told that winter has become colder and some supported that winter has become milder. Before 15 years, winter season got started from October and remained till March. But, nowadays, winter period has decreased from November to January only. It can be said that climate extremes have increased from the perceptions and multiple responses of respondents as 99% respondents respond that the weather is changing. But, according to available data on temperature from Ilam and Kanyam stations, very little change in average annual temperature (both max and min) has changed and information on rainfall is inconsistent between stations.

Table 1. Change in the climatic condition of Ilam, Nepal, 2013.

Climate changes	Percent (Multiple response)
Change in Weather	99
Increase in Temperature	92.3
Change in Rainfall Pattern	88
Change in Windstorm	65.3
Change in pattern of Drought	56
Decrease in Hailstone	53.7
Decreasing Erratic Rainfall	48.7
Increasing Erratic Rainfall	31
Change in Pattern of Hailstone	29.3
Decrease in fog	28
Increase in fog	23.7
Increase in Hailstone	12.3
Decrease in Temperature	9.3

3.2. Major Climatic Hazards

Different past major climatic hazards were analyzed using time line. Those hazards were investigated through group discussions with villagers. Then, they were gathered and presented on timeline below:

Table 2. Timeline of the climatic hazards (According to Nepalese solar system calendar bikram sambat).

Place	Events	Consequences
Godhak	Landslides (2045) Flood (2030, 2045, 2053, 2064) Drought (2034-35) Hailstone (2030 and 2064-65) Insect Pest (2052-53) Snow fall (2002)	12 household washed away, Loss of Cardamom field, Drought effects on Maize No cardamom Production since from 3 years Death of Fish lives Problems of rhizome rot, whitefly, Extinction of buckwheat*, Horse gram and* mustard Replacement of local breed cow *Jure* with Holstein and Jersey Arrival of new variety i.e. Tomato, Cow pea Squash and Pumpkin Extinction of Jackal and porcupine*, Rupi and Crow* and increment in Rabbit and Monkey Increment of *Variegata acranthus* 10-15 years ago, there was a problem of dew
Kanyam	Flood (2090, 2011, 2025, 2069) Drought (2028) Insect pests Hailstone Snow fall (2028, 2033-34) Hurricanes (2066) Dew (2068-69)	Loss of human lives and livestock 4 household migrated Washed away of mini bus carrying 14 people Washed away of cardamom and broom grass land No production of maize Replacement of indigenous crop with hybrid variety Extinction of Fox and Jackal since from 15 years and increment in rabbit Problems of aphid and mosquito since from 2 years Problems of rhizome rot Destruction of leach 1 man death due to hurricanes
Bhanjyang	Landslides Heavy Rainfall Hailstone Drought Frost Outbreak of new diseases	Landslides occur 45 years ago, which took away life of 7 people and washed away Nigure village. People recall that the size of the raindrop was so high that it made holes on roads and several other places. The rainfall was unexpected and strange; it occurred only in about 50 meters diameter 12-13 years ago, in the month of the Mangsir (Nov-Dec) shattered rice grain, causing more than 80% crop loss. Normal period for hailstone is Chaitra (March)-Baisakh (April) Liver fluke didn't exist in the past, but now it has become very common and sudden death of healthy-looking goats
Chulachuli	Flood (2036, 2048, 2070) Problems of snake Drought (2035, 2053,2069) Hurricane (2036)	2 people died due to flood On 2044 B.S. several households migrated At the time of paddy cultivation drought creates problem i.e. loss in productivity (1.5 man/ Bigha or 90 kilogram/hectare) 1 people injured due to the snake bite Several people died due to the malaria

	Increment in Wild elephant behavior Fire Epidemic of diseases Malaria (1932)	Agriculture land washed away Problems in moving because of destruction of check dam
Sangrumba	Landslides (2021, 2025, 2067 and 2069) Flood (2025) Hurricanes (2066) Fire (2054) Earthquake (1990 and 2068)	Extinction of Ducks 16 persons died due to landslides and loss on 4 means of transportation Loss in crop productivity 1 person died due to fire and in 1 household loss of property around 7 lakhs Problem of hurricanes on 44 households and schools Loss in 11 households due to earthquake

One of main reasons for the high level of vulnerability is the geology of the region itself. The soil is not very compact and thus heavy rainfall and medium size flooding can lead to serious erosion and landslides, with devastating impacts on farmland, houses, livestock, crops, roads, and consequently on human lives and livelihoods. Second, population is growing, which is increasing pressure of people on forests and farms. As a result, people are clearing more forests to till and grow crops and agricultural land use practice is becoming more intense than ever in terms of cropping pattern and the use of chemical fertilizers and pesticides. Therefore, people are doing agriculture in infertile land due to the infestation of the disease/ insects/ pest whereas some people are adopting new occupation and migrating from the area however migration is not the permanent solution to cope with these situations. Also as mitigation strategy the people are adopting techniques such as indigenous varieties, fertilizers, water harvesting technology, conservation and proper utilization of resources (plastic pond, deep boring, pump set, and sprinkler), resistant varieties and Integrated Pest Management technology followed through contour farming. Also Gavin construction and afforestation has been done to minimize the adverse effects from natural hazards.

3.3. Major causes of climate change and disasters

Between Bikram sambat 2002 and 2011, there were 4130 disasters recorded, resulting from natural hazards around the world where 1117527 people perished and a minimum of US $1,195 billion was recorded in losses. More people and assets are located in high risk due to rapid urbanization, human settlement, unsustainable development practices, ecosystem degradation, poverty as well as climatic variability and extremes have led to an increase in both natural and man-made disaster risk at a rate which poses a threat to lives and development efforts.

Table.3 Major causes of changing environment.

Changes in Environment	Percent
Deforestation	94.3
Human Behavior	89.7
Uncontrolled Population	71.3
Climate Change	54
Urbanization	29.7

3.4. Impacts of Disasters

These are the major impacts had been seen on the study sites such as according to respondents study shows that 93.7% respond that the sources of water resources are drying, 97.7% told that there

is the high infestation of insect pests that effect on agriculture as well as productivity, 42.7% seen early maturity in crops and 66% responds that there is the invasion of new crops as the weather changes also responds that there is the problem of diseases not only on human beings but in the animal species too.

Table 4. General impact of Disasters.

Impacts	Percent
Infestation of insect pest	97.7
Drying of water resources	93.7
Decrease in productivity	89.7
Increase in D/s infestation in crop	72.7
Increase in D/s infestation in Animals	62.3
Invasion of new crop	66
Early maturity	42.7
Flowering in forest	20.3
D/s in human beings	36.7
Increase in productivity	8.3

Table 5. Impact in agriculture, livestock and economy.

Impacts in Agriculture	Percent of Cases
Decrease in Productivity	92.5
Increase in Insect Pest Infestation	87.5
Agriculture land washed away	60
Effects on Livestock	
Decrease in Productivity	83.30
Loss of Fodder and Forages	77.80
Reduce in Productivity of livestock	53.60
Diseases	38.60
Livestock washed away	2.40
Impacts in Economic Resources	
Low in Productivity	95.6
Reduction in income	88.2
Disease	32.1
Starvation	4.4

3.5. Effects in Environment Due to These Disasters

Most of the people supported that, disasters effects the environmental condition by different means such as decrease in surface water which not only creates drought but also the problem of drinking water, increase in pollution, loss of biodiversity, loss of human / animal lives due to diseases and insects pests.

Indigenous knowledge and skills of natural resources management also offer opportunities to manage disaster. This is because the management of natural resources is one of the significant aspects of disaster management. Various communities of Nepal have retained indigenous knowledge and skills in managing natural resources, particularly, forest and water resources which are the major causes of both managing and contributing disaster. They have skills in harvesting trees and the protection of water resources. Currently, forest resources are being managed by the community users'

groups. This system of management of natural resources facilitates implementation of the disaster management system.

Table 6. Disaster effects in Environment.

Effects in Environment	Percent of Cases
Decrease in Surface Water	94.6
Pollution	74.2
Loss in Biodiversity	50.3
Loss of Lives	6

3.6. Local Mitigation Methods

To cope with this situation people adopt to initiate early warning and monitoring system through different local organizations, cooperatives and social media, alternate agriculture (poultry raising, mushroom cultivation, tunnel/greenhouse farming, short-duration crop cultivation (e.g. hybrid), cultivation of drought-tolerant crops and crop varieties (e.g. taro, yam, millet, sathiya local variety of maize. As well as formation of hamlet development institutes and social network, mobilization of youth to create awareness and exchange the information and facilitate participatory decisions are the major techniques that the Ilam district is going through to lessen the calamities.

Table 7. Mitigation Methods used by respondents.

Mitigation methods for landslide	Percent of cases
Afforestation	97.7
Contour Farming	78.9
Awareness	51.6
Check Basin	48.4
Change of Place of House	11.7
Reconstruction of Shed	3.1
Loan for household activity	3.1
Mitigation methods for flood	
Check basin	92.9
Awareness	92
Loan for household activity	13.3
Change of place of house	7.1
Reconstruction of shed	5.3
Mitigation methods for drought	
Conservation and Utilization of Resources	89.6
Drought Resistant Variety	40.7
Construction of Plastic Pond	8.6

3.7. Social Network

Social network is a social structure made up of a set of social actors (such as individuals or organizations) and a set of the dyadic ties between these actors. The social network perspective

provides a set of methods for analyzing the structure of whole social entities as well as a variety of theories explaining the patterns observed in these structures. The study of these structures uses social network analysis to identify local and global patterns, locate influential entities, and examine network dynamics. According to respondents major sources of the information they got are Radio, TV and also from relatives, neighbors and friends. Social media allows everyone to play the role of the journalist in sharing events that are happening all around them.

There are different sources of information such as television, radio, friends, relatives and the neighbors and the study shows that 97% shows that they got information from the radio as it is the best and cheap to have in the home. As the district have many more organizations, non-organizations, institutions and clubs that are working in the field of climate change and disaster but the study shows that only 30.7% respondents got help after arrival of disaster.

Table 8. Respondents helped each other through different means.

Help Others	Percent in Cases
Helping hands	77.4
Information	61.6
Giving basic needs	48.4
Loan	18.3

Respondents helped each other when there is the problem of disaster by giving basic needs such as clothes, shelter for living and foods. Some help by giving them loan and some help by giving information to cope with that disaster risks.

4. Conclusion and Recommendation

Climate is changing and leading to different natural hazards. People are using their indigenous knowledge and technology to cope with these disasters. Some new interventions such as rainwater harvesting for drinking and perennial agriculture, water and crop nutrients conservation farming, promotion of drought tolerant crop, for example, sweet potato and sorghum, seed multiplication and crop diversification and communal gardening can be done for the sustainable livelihood option.

Vulnerability and resilience have mutually dependent effect on the communities coping with different situations. When one is increasing the other decreases, meaning that strengthening people's resilience leads to better coping mechanisms and the vulnerability is reduced. The best possible outcome of decreasing people's dependence on outside resources and assistance is that it might lead to better stability of the district.

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