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Climate change, poverty and livelihoods: adaptation practices by rural mountain communities in Nepal

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ABSTRACT

Effects of climate change tend to be more severe where people rely on weather dependent rain-fed agriculture for their livelihoods. In rural mountain communities with limited livelihood options, adaptive capacity is low due to limited information, poor access to services, and inequitable access to productive assets. Few studies have reported on the current status of rural and remote mountain areas in Nepal with little known about adaptation strategies in use. This article is based on a study in the remote mountainous Jumla District of Nepal to explore how climate change is affecting the livelihood of local communities and how different wellbeing groups are differentially impacted. Looking from a wellbeing lens, adaptation practices by households as well as local support mechanisms were explored to predict the severity of effects now and into the future. Using a climate vulnerability and capacity analysis (CVCA) process, major climate hazards and their effects on livelihood resources were analyzed. In addition, participatory social research methods were used to analyze the coping strategies of different wellbeing groups. Results show that changing weather patterns have significantly challenged the livelihoods of a community, experiencing resource degradation, food scarcity, lack of basic services, and increasing social inequalities. The changing climate is an additional burden to the poor people in the mountains who are already living in poverty, are vulnerable and excluded with predictions of additional risks to livelihoods and further inequity in the future.

1. Introduction

Scientific evidence of climate change and predictions of potential serious impacts in the near future on the world's poor are often expressed in the literature (Adger et al., 2003; Agrawal and Perrin, 2008; Hedger et al., 2008; IPCC, 2001a; Pounds et al., 1999). For example, the Millennium Ecosystem Assessment (2005, p. 13) realizes climate change as one of the major contributing factors for degradation of ecological services and argues that "*the degradation of ecosystem services is harming many of the world's poorest people and is sometimes the principal factor causing poverty*". Ongoing poverty, lack of social safety nets and lack of access to education and health care increase vulnerability to climatic change for the poor (Adger et al., 2003; Smit et al., 2000). According to the Intergovernmental Panel on Climate Change (IPCC, 2007a), countries in temperate and tropical Asia are likely to have increased exposure to many extreme events, including the possibility of glacial melts, floods and landslides, rising sea levels, large-scale inundation, recession of flat sandy beaches, increased fire risk, water stress, typhoons and tropical storms, and vector-borne diseases.

Although Nepal's contribution to global emissions is negligible, the adverse effects of climate change on Nepal

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are significant due to its fragile economic and environmental base. From 1977 to 1994, the average temperature in Nepal increased by 0.06 degrees Celsius annually (Ebi et al., 2007; Shrestha et al., 1999, p. 2775). The warming has been higher in the mountains than the global average over the last 100 years (Du et al., 2004; IPCC, 2007a), and is also higher in comparison to lowland Terai in Nepal (Xu et al., 2007). The changing precipitation patterns, warming, and glacier recession are providing a new identity to the mountain regions as a climate change hotspot and these changes have potentially serious consequences for mountain ecosystems and people, as well as for the downstream regions (Macchi, 2011; Shrestha et al., 2000; World Bank, 2009). Some of the observed impacts of climate change in the mountains have been: erratic rainfall and the unpredictable onset of monsoon seasons, glacial retreat, storms, landslides, and drought. These occurrences have impacted crop failure and increased food and livelihood insecurity, water scarcity and added to income insecurity (Kohler et al., 2010; Macchi, 2011; Marston, 2008). More than 60% of the cultivated area in Nepal is fully reliant on monsoonal rainfall (CBS, 2006, p. 63) and the unpredictable weather patterns are affecting production of staple crops (Lohani, 2007; Mala, 2008; Regmi, 2007; Urothody and Larsen, 2010). In addition, the people in the mountain are living in isolation and tend to be politically and economically marginalized, more so than populations elsewhere (Kohler et al., 2010; Marston, 2008; Zurick and Karan, 1999).

There is very limited knowledge and information available on how specific climate hazards are impacting the livelihoods resources, how climate change is impacting on different wellbeing groups and how poor people in the mountains of Nepal are responding to the climate changes. The analysis of differential impacts of climate change is very important in the historically hierarchical society of Nepal where poverty exists extensively based on the rural–urban, geographical, gender, and caste/ethnic divisions (CBS, 2005; Murshed and Gates, 2005). This paper reports on a research study which considers the impacts of climate change on rural poor people living in the *Jumla* District of the remote mountain region in Nepal. The research investigates: (i) what are the major hazards impacting the livelihoods of rural communities; (ii) how does climate change differentially impact on the livelihoods of particular wellbeing groups the changes, and (iii) what are the adaptation practices (responses) currently adopted by different wellbeing groups?

2. Climate change adaptation in the context of poverty and rural livelihoods

Several studies have shown the importance of adaptation strategies that rural people can engage in to cope with climate change (Adger et al., 2003; Hulme and Shepherd, 2003; IPCC, 2001b). Adaptation is a planned approach that deals with adjustment to socio-economic and ecological systems in relation to climate change and its consequences (Gallopin, 2006; Smit et al., 1999). Adaptation is commonly considered as an ability of society to act collectively forming social capital (Adger, 2003). The capacity and scale of adaptation to climate change depends on the vulnerability of people and natural systems to the impacts. The vulnerability ''is *the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt*'' (Adger, 2006, p. 268). Adaptive capacity is context-specific and varies among countries, among communities, among social groups and individuals, and over time (Smit and Wandel, 2006).

Reducing individual and society's vulnerability to climate change is closely linked to the poverty reduction, as poverty is both a condition and determinant of vulnerability (Tanner and Mitchell, 2008). Poverty is usually understood as an individual's or household's ability to obtain basic goods and services where income and consumption are basic parameters (Coudouel et al., 2002). According to Sen (1999), poverty is associated with insufficient outcomes related to health, nutrition and literacy, as well as with weak social relations, insecurity, low self-esteem and powerlessness. Sen (1999) argues that the basic capability of people enhances their ability to question, challenge, propose and influence new actions. Poverty is also linked to social justice and defined as the ''*inability to participate, due to inadequate resources*'' (Whelan, 2007, p. 212). Thus, a multidimensional perspective on poverty is emerging inclusive of a broader picture of deprivation, social variables, relationships and structural dimensions (Curwood and Eckerle, 2009; Frye, 2008).

Resource dependent communities, historically, have managed weather-dependent natural resources such as forestry, fish stocks, livestock and water resources, experiencing collective adaptation practices (Adger, 2003; Agrawal, 2001; Alexander et al., 2010). However, adaptation strategies by rural communities are targeted to respond to short term shock events rather than as planned initiatives (Ellis, 1999; Nuorteva et al., 2010), are autonomous and reactive rather than strategic (Bates et al., 2008; Smit et al., 2000), and generally applied in socio-economic sectors where capital investment is low (Sohngen and Mendelsohn, 1998). Documented examples of rurally managed adaptation practices are mostly related to crop diversification, irrigation, water management, disaster risk management and providing insurance (IPCC, 2007b). Observed and projected risks are more profound where livelihoods of rural populations are primarily dependent on natural resources (Agrawal and Perrin, 2008; Paavola and Adger, 2002; IPCC, 2007b). Emerging evidence indicates that adaptation and coping strategies by the poor in developing countries are highly varied and local-level studies are needed for development policies to be effective (IPCC, 2007b). This study links climate change impacts on rural livelihoods in the context of poverty in the remote mountains.

3. The context of livelihoods and climate change in the research area

Research was conducted in the *Lamra* village development committee (VDC) of *Jumla* District in the mid-western mountain region of Nepal (Fig. 1). The *Jumla* District is one of the remote and underdeveloped districts of Nepal with a human development index of 0.348, a human poverty index of 56.8, life expectancy at birth at 50.82 and an adult literacy rate of 26.6 percent with overall human development ranking in 70

Fig. 1 – Location of the research site (Lamra village, Jumla District) in a map of Nepal.

out of 75 districts in Nepal (UNDP, 2004, pp. 143–144). These indicators show that the research site is well below national Nepalese rates. The remoteness is characterized by poor infrastructure such as roads, schools, hospitals, electricity and communication, poor services and limited access to markets.

The population of the *Lamra* VDC in 2008 was 2668 in 483 households and adult literacy was only 34% (NAVIN, 2011). The basic occupations are agriculture followed by wage labour and seasonal migration to India. The research site is known as a unique place where rice is cultivated at the highest altitude (up to 3000 m) in the world (Paudel and Thakur, 2009; Uhlig, 1978). In addition to rice, barley, maize, potato and millet are common crops which are dependent on rain/snow fed irrigation. Livestock rearing is used to provide a key source of transportation as well as for draught power, meat and income. A significant amount of food is supplied every year from outside the District. Besides agriculture, the collection and trade of non-timber forest products is a source of income and supports people's livelihoods. However, due to a lack of recognition of local and community based management systems, and inadequate law enforcement to prevent illegal trade, the benefits of trade is lost for both local collectors and for the country (Larsen, 2002). People turn to seasonal migration to India for work as another source of income supporting their livelihoods.

In recent years, there has been a decrease in crop production, crop failure and low productivity in the District caused by uncharacteristically changing weather patterns (Sapkota et al., 2010). Serious impacts were observed in the decreasing production of traditional variety of high altitude rice in the district. Although, new varieties of rice were recently introduced they were also found to be unproductive in comparison to local varieties due to adverse climate (Sapkota et al., 2010). The authors indicate that lack of irrigation infrastructure, erratic rainfall, long periods of drought, decreased soil moisture, loss of soil fertility and wind erosion are some of the causes of decreased crop productivity. This context provides a rationale to study how poor people are coping in the changing context now and how they perceive their future.

4. The research methodology

Participatory and qualitative research methods such as Climate Vulnerability and Capacity Analysis (CVCA), Focus Group Discussions (FGD) with different well being groups, key informant's interview and participant observation were applied in the research. The meteorological data from the nearby reporting station was collected and analyzed to validate the changes in temperature and precipitation patterns. Objectivewise research methods are discussed in the following sections.

4.1. *Participatory analysis of climate vulnerability and rural livelihoods*

The participatory rural appraisal (PRA) and related techniques (Chambers, 1983, 1994; Chambers and Conway, 1992) have been commonly applied in assessing livelihoods, vulnerabilities and risks related to disaster and climate change. The human dimensions of vulnerabilities related to natural disasters have been well documented and used in development studies (Benson et al., 2001; Blaikie, 1994; Scoones, 2009). Some of the methods and tools in assessing climate vulnerability in relation to livelihoods are: climate vulnerability and capacity analysis (CVCA) methodology developed by CARE International (Daze et al., 2009); Vulnerability to Resilience Framework (VRF) developed by Practical Action (Pasteur, 2010); frameworks for assessing vulnerability to climate change developed by IUCN (Marshall et al., 2009); and climate change and environmental degradation risk and adaptation assessment (CEDRA)–toolkit practiced by Tearfund (Wiggins, 2009). Similarly, participatory tools developed and applied by Oxfam (de Dios, 2002); livelihoods and forestry program (LFP)/UKAid (Regmi et al., 2010); WWF India (Mohan and Sinha, 2010); UNDP-Adaptation Policy Framework (Lim et al., 2005); and International Centre for Integrated Mountain Development (ICIMOD) (Macchi, 2011) are also in use in the assessment of climate related vulnerabilities.

In light of the available participatory vulnerability assessment methods, the CVCA methodology was applied for climate vulnerability and capacity analysis. The methodology helps to better understand the implications of climate change on people's livelihoods; examines both hazards and conditions of poverty and analyzes the interactions between them; promotes multi-stakeholder analysis; and the process focuses on the role of institutions and policies in adaptation. The methodology comprised several participatory tools including hazard mapping, seasonal calendars, historical timeline of

Table 1 – Climate vulnerability and capacity analysis tools and outcomes of the analysis.

Major tools	Process and outcomes of the analysis
Hazard mapping	A participatory hazard map of the village was prepared. Settlement areas, major livelihood resources, resources at risk from climate hazards and support institutions were located on the map. Access to and control over major livelihood resources and services by different wellbeing groups and physical locations of the community were presented and discussed.
Seasonal calendars	Periods of precipitation, agricultural works, employment, festivals, migration, stress, hazards, diseases, hunger, debt and other vulnerabilities realized by the community were discussed and included in the yearly calendar. Rainfall patterns and changes in seasonal activities and coping strategies were discussed. Use of climate information in planning processes of service providers was discussed.
Historical timeline	Historical timeline of the village was prepared with major political, social, cultural and environmental events during the last 30 years. The frequency and trends of major weather events and hazards such as-perceived warming, droughts, landslides and precipitation were listed and discussed. The changes in cropping patterns, changes in land use, land tenure, changes in food security and nutrition, as well as the beginning of different services, networks and facilities were discussed.
Vulnerability matrix	Major climate hazards and livelihood resources were identified and listed in a matrix by the community. Major hazards and most impacted livelihood resources were prioritized in the matrix. Scoring for the hazards against the livelihood resources was carried out and coping strategies currently applied by the community were identified.
Venn diagram	A Venn diagram indicating the proximity and usefulness of services from a variety of different service providers was prepared. The institutions most important to local community, their proximity and contact details were explored. Access to services, availability of information, safety nets and governance (transparency, accountability, participation) mechanisms were also discussed. The level of engagement of local community in the planning process of service providing institutions was discussed.

Adapted from Daze et al. (2009).

livelihoods activities, vulnerability matrix and stakeholder analysis using a Venn diagram (Table 1). A team of local community representatives were briefed the methodology in the research site representing different settlements, ethnic groups, castes and genders. Then the produced maps, posters and other findings were presented in a plenary of community members to validate and confirm the information.

The application of CVCA in this research had several strengths as the local community easily understood and adopt the process and the information produced in visual diagrams and maps were easily triangulated and validated by the community. The method in this research was also applied as a tool to triangulate data generated from other sources. In between the strengths, the limitations of CVCA were also observed in its application. The method in general was a resource (time, money) consuming process; it was difficult to test validity of information; and there was a general trend to dominate the discussions and influence the conclusions by local elites.

4.2. *Assessment of differential impacts and adaptation practices*

A participatory wellbeing ranking of households (Mosse, 1994) was conducted to categorize the local population in terms of relative poverty into poor, medium and rich/well-off groups based on local criteria of wellbeing. The major criteria considered by the community in wellbeing ranking were food sufficiency, land ownership (amount and quality), education, income, employment and financial loans (Table 2). The community representatives were involved in the ranking and all disputes were solved by consensus.

Following the participatory well being ranking, three separate focus group discussions with each well being group (well-off, medium and poor) were held. The data was compiled to enable a comparison of the differential vulnerabilities and adaptation practices (responses) between these groups. Similarly, key informant's interviews were conducted with village leaders, school teachers and elder farmers in the village

Table 2 – Criteria, indicators and status of well being analysis.

Major criteria applied	Well being status of the community and common indicators		
	Well-off (96 households–20% of total)	Medium (146 households–30% of total)	Poor (243 households–50% of total)
Production/sufficiency	Food production throughout the year, sale of surplus grains	Food production for six months an average	Food production for three months or less
Land	Large irrigated land non-irrigated land	Limited irrigated and non-irrigated land	No irrigated land and limited non-irrigated land
Education	Children admitted to private schools	Children admitted to public and also private schools	children admitted to public schools
Employment	At least one member per family has a job or service	Seasonal migration to India, job in few cases	Sell labour in the local market and seasonal migration to India
Money lending and loaning	Lend money in the local community	Loan taken, rarely lent	Taken consumption loan and indebted

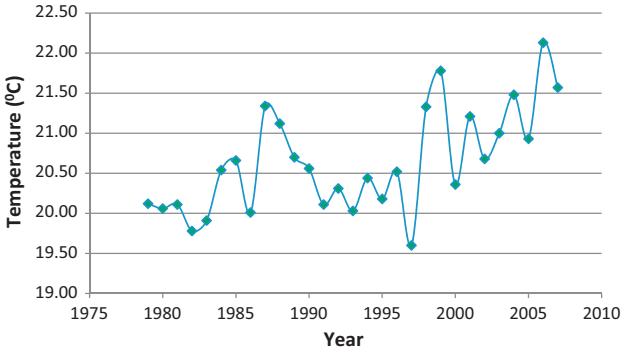

Fig. 2 – Variation of mean annual maximum temperature in the last 30 years.

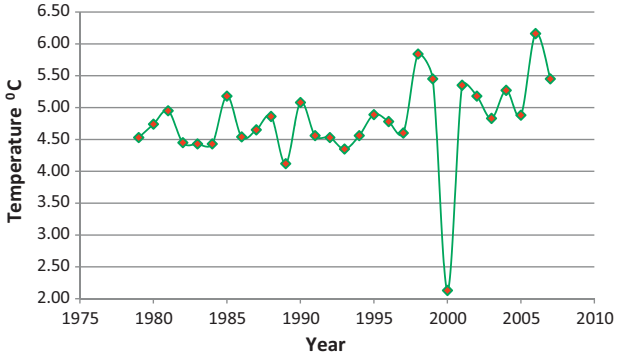

Fig. 3 – Variation of mean annual minimum temperature in the last 30 years.
***Source*: Department of Hydrology and Meteorology, Government of Nepal (2010).**

and district headquarters to collect and validate the information.

In addition to information from the field, meteorological information of the last 30 years from a nearby recording station was collected from the Department of Hydrology and Meteorology, Government of Nepal (DHM, 2010). The meteorological data (1979–2008) was analyzed to relate and validate the temporal and spatial variations in temperature and precipitation with observed impacts (Figs. 2 and 3 and Table 3).

5. Results and discussion

5.1. *Changes in temperature and rainfall*

5.1.1. *Increasing temperature*

An analysis of temperature records over the last 30 years available from the nearby meteorological station in *Jumla* showed a gradual increase in both mean maximum and mean minimum temperatures (Figs. 2 and 3). Although the average temperature shows an increasing trend, the data were highly variable. For example, the mean maximum temperature ranges from 21.78 °C in 1999 to 19.6 °C in 1997. Similarly, year 2006 and 2000 had the highest mean minimum temperature (6.1 °C) and lowest mean minimum temperature of 2.13 °C respectively.

These statistical changes were then compared with impressions and opinions of local communities in focus group discussions, key informant's interview and CVCA as per the methodology. Similar observations related to the increasing trend of warming, erratic precipitation and its impact on agriculture production were reported by the communities during the CVCA analysis and focus group discussions. Some impacts were reported in relation to decreasing drinking and irrigation water sources in the wells, ponds and springs. Consequently, an increasing trend of water and vector-borne diseases were reported. Similarly, a decreasing trend of grazing lands and reduced availability of non-timber forest products were reported due to prolonged drought, limited winter rainfall and over exploitation of resources.

5.1.2. *Erratic and low precipitation*

A noticeable variation in precipitation patterns over the last 30 years has occurred (Table 3). The mean total annual precipitation in *Jumla* during the last 30 years from 1979 to 2008 was only 816 mm which is very low in comparison to the national annual average rainfall of 1800 mm (MoE, 2010, p. ix). A general trend of decreasing mean annual, winter, pre-monsoon and post-monsoon winter rainfall was observed. During June to September, the monsoon precipitation had slightly increased. The rainfall pattern was analyzed in critical agriculture periods using both meteorological data and farmer's observation in focus group discussions. A trend was observed in decreasing winter rainfall remarkably in December, a month when the farmers expect rainfall for their winter crops. Average winter rainfall in December was found in a decreasing trend from 28 mm (in 1978–1988 decade) followed by 13.3 mm in 1989–1998 and 4.5 mm in a decade from 1999 to 2008. Similar trend was also observed in March and June when farmers expect rainfall for seedbed preparation and plantation of rice as a major crop.

5.2. *Major hazards to livelihoods resources*

As part of the CVCA analysis, a vulnerability matrix of the *Lamra* VDC was prepared (Table 4). The communities identified

Table 3 – Pattern of precipitation (mm) in the last 30 years.

Year	Total annual (January–December)	Mean winter (December–February)	Mean pre-monsoon (March–May)	Mean monsoon (June–September)	Post-monsoon (October–November)
1979–1988	852	31	62	131	25
1989–1998	809	31	47	133	22
1999–2008	787	21	48	139	13

Source: Department of Hydrology and Meteorology, Government of Nepal (2010).

Table 4 – Vulnerability matrix of *Lamra* VDC.

Major hazards Major livelihood resources	Erratic rainfall	Drought	Landslides	Water/vector borne diseases	Rank
Rice cultivation	3	3	1	0	I
Winter crops	3	2	1	0	II
Wage labor	2	1	0	1	IV
Livestock (forage and grazing)	1	2	1	1	III
Seasonal migration to India	1	0	0	0	V
NTFP collection	2	3	0	0	III
Total score and rank	12 (I)	11 (II)	3 (III)	2 (IV)	

Source: CVCA analysis in Lamra VDC, October 2010.
Scores: significant impact-3; medium impact-2; low impact-1; and no impact-0.

erratic rainfall, drought, landslides and diseases as major hazards. Prioritized livelihood resources were agricultural crops, wage labor, livestock rearing, seasonal migration to India and collection of non-timber forest products (NTFPs). Each hazard was scored against the livelihood resources with significant impacts on the resources. Based on the analysis, the most vulnerable hazards identified by the community were decreasing and erratic rainfall patterns and drought directly affecting the rain-fed agricultural practices (Table 4).

5.3. *Effects on agriculture*

The communities in all three focus group discussions, and also in the historical timeline of the village, reported a decreasing and erratic trend of pre-monsoon and monsoon rainfall in recent years. The trend has also been supported by meteorological data received from nearby recording station. The communities reported a massive reduction in food production. The poor households claimed that they have not grown rice for the last three years as they only owned rain-fed land for rice cultivation. The poor households of *Hiyarkhola* village reported that they replaced their paddy field with wheat and *Chino* (Ragi, a traditional crop variety) for the last three years. The well-off and medium households also reported losing rice cultivation in rain-fed lands but continue rice production every year from their permanently irrigated land across the river banks. Instead, the well-off households reported vegetable farming has been introduced as a crop diversification strategy. The well-off households shared that they were selling non-irrigated lands and buying irrigated lands across the river to secure their crops.

The farmers of all wellbeing groups reported and presented in the historical timeline that the productions of winter crops (wheat, barley, corn, potato and chino) had also been massively decreased due to lack of winter rain/snowfall. They claimed that winter crops required regular snow/rainfall to maintain soil moisture. The poor farmers with non-irrigated land reported that they were also seriously affected by the failure of winter crops. The communities of all wellbeing groups were demanding provisions of crop insurance and better access to credit in times of crop failure. Similarly, there was a demand for new crop varieties and water harvesting technologies.

Farmers experience with erratic pre-monsoon and winter rainfall was also justified by meteorological data (Table 3) and crop failure was also reported by the researchers (Sapkota et al., 2010) and key informants. The unpredictable rain/snowfall was mainly responsible for the failure of rice and winter crops. As reported by farmers in the focus group discussions and key informant interview, changes and unpredictable pattern of rainfall and drought in particular crop production time were increasing uncertainty and crop failure. A key informant, an agriculture specialist, reported that the agricultural practice in *Jumla* is unique and very much climate sensitive, especially for the cultivation of the weather sensitive local variety of high altitude rice "*Jumli Marsi*". Rice cultivation in *Jumla* is based on local knowledge and traditional practices. The farmers must start seed bed preparation in the last week of March and the two months old seedlings are planted within two weeks from the last week of May (Sapkota et al., 2010). Any delay in seedling production and planting in the given timeframe results in crop failure for that year. The key informants reported that due to the high intensity of wind in the district, irregular rain/snowfall decreases soil moisture very quickly and affects the production of winter crops.

5.4. *Resource degradation*

Local communities in all three focus group discussions and hazard mapping reported that the source of irrigation and drinking water in the springs and wells was decreasing. They claimed that the drought, followed by limited winter rain/snowfall, had also affected the rangeland and forests and impacted on grazing of livestock and collection of non-timber forest products (NTFPs). The experiences were also supported by meteorological data that indicates decreasing trend of winter, pre-monsoon and post-monsoon rainfall. Poor households reported that the collection of NTFPs, one of their major sources of income, is decreasing every year. Similarly, a decreased number of livestock following the continuous drought in the grazing land was also reported by the community. The increasing trend of timber logging in the nearby forests following the road access was reported in all discussions and hazard mapping.

Communities stated that the livestock rearing has been affected by limited and less productive grazing land due to low moisture content and over exploitation of available resources. As a result poor people, who mostly graze their livestock and cannot afford stall feeding, have reduced their herds of livestock. The unmanaged logging of trees in the nearby forests was also observed during the field research. Two major reasons were observed that facilitated the recent trend of

resource degradation. Firstly, there was increasing internal pressure to harvest and sell both timber and non-timber forest products as a coping strategy of survival after repeated crop failure. The road access had expanded marketing of those resources. Secondly, following the road access to the district, there was increasing internal migration and settlement of people along the highway and district headquarters consuming a high amount of timber and stones for construction. It can be projected that the unplanned exploitation of resources will further accelerate resource degradation and scarcity.

5.5. *Institutions and services*

The local schools, health post, saving and credit group, Community Forest User Groups (CFUGs) and irrigation group were identified as major service providing institutions in the Venn diagram of the village. The CFUG was the most important local institution identified by the community. There were five CFUGs in the VDC covering a 145 ha area. The hazard map and Venn diagram showed that the CFUGs were the sources of timber, fuel wood, fodder, agriculture tools and thatching grasses. However, the conditions of the community forests were not sufficient to address local demands. Three CFUGs had only timber for sale but the price was beyond the affordability of poor households. Funds from the sale of timber by CFUGs were invested into local community development activities such as construction and maintenance of schools, irrigation canals and roads. The chairperson of one of the CFUGs reported that *''although all CFUGs in the VDC had undertaken wealth ranking of households as required by procedural requirements of community forestry, no affirmative action to support pro-poor livelihoods was in practice''*.

Participant observation and follow up interview with key informant of local VDC showed that the annual plan of the VDC had a major focus on infrastructure development and no emphasis on social protection schemes. Programs to support climate change adaptation were not in the VDC and district level plans. There was a strong presence of international non-government organizations in the research area and these organizations were supporting food supply, infrastructure development or awareness related activities.

The support mechanisms of service providers, including the government, were on an *ad hoc* basis without proper planning and coordination. Institutions supporting crop and livestock insurance were not accessible or in use in the District. Although there is a mandatory policy provision to invest at least 35% of CFUG income in pro-poor activities (GoN, 2009), it was not in practice in the research area. Similarly, there were no practices in place to provide forest products or money for the families in emergency except free timber for ritual purposes.

Recently, the district introduced road access to the district headquarters, greatly improving transportation of food and other essential commodities. However, with improved road access, unplanned urbanization has increased in and around the district headquarters and along the highway. This has resulted in deforestation and extraction of stones and soil from the community and from government managed forests.

5.6. *Differential vulnerability based on assets*

The hazard map showed that the poor households were residing in the areas close to landslide and water scarcity, which is further vulnerable to climate hazards. The discussions and analysis concluded that the distribution and quality of land was related to the wellbeing status of households. It has been observed that the poor households have very limited and non-irrigated lands while the well-off households have irrigated lands with surplus production of food. The well-off households also reported that they were using their landownership with productive landholdings as collateral for loans from financial institutions. In contrast, the poor households reported that they have no access to formal financial institutions due to lack of collateral. The impacts of erratic rainfall and drought were observed to be higher in non-irrigated lands than irrigated lands. The poor households without irrigated land were found to be facing greater risks related to crop failure and stresses than well-off people.

The climate vulnerability was observed to support the historical marginalization process in the rural agriculture based society where land is the major source of asset and identity. Similarly, households with better education and financial assets had more livelihoods options to diversify their income sources. Thus the underlying causes of poverty and marginalization were directly related to impacts of climate change as people who owned more assets and ability were less vulnerable (Adger, 2006; Ellis, 2000; Smit and Wandel, 2006).

5.7. *The adaptation practices*

Poor households reported that they were compelled to withdraw their children from the school for labor work, and sold their seed stock, kitchen utensils and livestock in times of scarcity. Selling labor in the local community and seasonal migration to India was also used as a common coping strategy by the poor. The poor community reported that, although seasonal migration to India is a traditional strategy, more households are migrating in recent years with children and women accompanying their male counterparts and parents. In contrast, the well-off households were practicing storage of grains, cash saving, purchasing irrigated land and money lending. An increasing trend of vegetable farming for self-consumption and sale in local markets was indicated in irrigated lands owned by well-off households. Similarly, most of the well-off and some medium households reported that they are also exploring new agriculture technology, new crop varieties as part of the diversification of livelihood options (Table 5).

Food consumption was changing, especially in poor households, due to crop failure and low production. Women from poor households reported that they were eating more millet and *chino*, although less preferred than rice. They explained that eating rice every day is associated with the wealth and power in the rural Nepalese society. Food was very expensive as deficit food supplied from Terai added high transportation costs.

Almost all households in the study area depended on subsistence agriculture. Although all households have faced crop failure in recent years, the adaptation practices by each

Table 5 – Climate change effects and responses by different wellbeing groups.

Observed changes and effects	Wellbeing status	Effects on livelihoods	Coping strategies		
			Household	Civil Society (community institutions)	External (market and state)
Decreasing and erratic precipitation, low pre-monsoon and winter rainfall	Well-off/rich	Decreased production of rice and winter crops, decrease in livestock numbers	Changing cropping pattern, storage of grains, cash saving, selling non-irrigated land and purchasing irrigated land, lending out money	Benefits from saving and credit groups, irrigation user groups, community forestry user groups (CFUGs), farmers' groups	Accessing new agricultural technologies, new crop varieties, diversification of livelihood options
Increasing mean maximum and minimum temperature	Medium	Limited production of rice and winter crops, decrease in livestock numbers, scarcity of resources	Changing cropping pattern, storage of grains, cash saving, selling properties (livestock/land), increased seasonal migration, shifting towards skilled jobs	Joined saving and credit groups and CFUGs for cash material and social support	Access to skill based jobs, livelihood diversification
Prolonged drought drying pasture land and water sources	Poor	No production of rice, limited production of winter crops, food deficit and hunger, debts	Changing cropping pattern, sale of property (seed, utensils, garments, livestock, land), changing food behavior, consumption loan from local lenders, selling labour in the local and Indian market, children dropping out of school and sent to do labouring work	Joined CFUGs and saving and credit groups (limited), not able to influence decisions for capacity building and affirmative action in benefit sharing	No market based livelihood diversification due to lack of land, education and skills

Source: Field survey in the research site, October 2010.

well being group was markedly different (Table 5). Poor households were concerned about day to day problems and lacked a longer term vision. Medium and well-off households with better access to agriculture service providers were exploring new varieties of rice and wheat. Poor households were only mobilizing their household efforts while the medium and well-off households were benefitting from the services provided by local civil society institutions, markets and state agencies. The adaptation practices adopted by poor households were further pushing them towards more vulnerability and marginalization. Similar nature of adaptation practices has been reported in the areas of chronic poverty (Barnett et al., 2008; Tanner and Mitchell, 2008). Table 5 presents a summary of differential effects of climate change and coping strategies adopted by different wellbeing groups as reported in the focus group discussions.

5.8. *Consumption loan for adaptation*

All poor family members who participated in the focus group discussions had a loan taken in emergencies of food scarcity, illness, purchasing education materials for children and to manage seasonal migration to India. They also reported that loans to poor households have increased during the last three years following crop failures. None of the members knew when and how to repay the loans – the simple way to reduce a loan was to work as a farm labourer for money lenders who mostly pay wages below the standard rate of the district, with wages commonly paid in grains. The communities reported that a local saving and credit group run by women members collected 50 rupees per member per month with an interest rate of 24 percent per year. The very poor were not the members of a saving and credit group due to a lack of contribution funds each month. The saving and credit groups had no provision for special loans at times of emergency, so poor families relied on local money lenders with loans requiring a minimum interest at 36 percent per year, a high rate of interest for poor households who are compelled to take a loan for consumption.

The consumption loan was another coping strategy for the poor for their survival, now pushing poor households towards indebtedness and a vicious cycle of poverty. The money lending practice places stress on poor families, promotes exploitation, and the poor experienced unequal power relations in their society. As discussed earlier, access to credit was linked with capital as collateral, and lacking access to land as a capital hinders poor households from obtaining various benefits.

6. Conclusion

Experiences described by the respondents and supported by meteorological data revealed that there were changes in climate with negative effects on people's livelihoods in the research area. With limited livelihood options, people in the research area were affected by unseasonal weather events, remoteness, poor asset bases and poor services. Agricultural production, important for subsistence livelihoods, was increasingly uncertain and increasingly risky due to erratic rain/snowfall and

frequent drought. Livestock grazing and collection of the NTFPs were also under threat due to changing weather patterns and over-exploitation of natural resources. The effects differed amongst people ascribed to several wellbeing groups with higher impacts for the poor who lived in vulnerable sites, depended on rain fed subsistence agriculture, own little land or other physical assets and have low education and skills they could use to benefit their livelihood strategies.

Communities appear to be struggling to adapt to their changing environment with their limited knowledge, poor assets and inadequate external support. Common practices of adaptation of agricultural production were crop diversification and selection of drought resistant crops. These responses were autonomous, short term and used on an *ad hoc* basis. Immediate support in the areas of crop diversification, water harvesting and sustainable management of natural resources is needed by the local community. With the failure of new crop varieties, there was also a need for research into agriculture and natural resources to better understand, test and adopt new technologies, methods and services.

Within the agricultural sector, poor households have limited options due to limited land ownership, decreasing numbers of livestock and depletion of forest resources; however, the well-off people, who owned irrigated land, were introducing some vegetables and other crop varieties. Poor people were coping by using household efforts and with limited support from the local institutions, while the medium and well-off households were utilizing household, community, government and market services for the diversification of livelihood resources and options. Poor people are not adapting but rather just coping. Several coping strategies such as labor migration, using children at work and increasing consumption loans appeared to be pushing poor communities towards indebtedness and a vicious cycle of poverty with additional vulnerabilities and risks. It is also sustaining and promoting traditional inequities in power relations within their society.

We suggest that climate change adaptation should not be considered as an isolated strategy but rather as part of ongoing development initiatives to overcome poverty, marginalization and to buffer against environmental vulnerabilities. Although the climate change effects are more pronounced at a local level, the responses should not be limited to local actions. Rather an integrated approach based on national and district level pro-poor policies and strategies could be used to link with mainstream efforts for planning and equity in distribution. Adaptation requirements of poor households are much higher than the powerful and well-off groups and hence there is a strong rationale for supporting pro-poor investments. Firstly, poor households need social protection schemes such as cash for work, access to credit, crop and livestock insurance and improved ways to ensure food security. Secondly, better access and improved governance of basic services such as agricultural extension, cooperatives, education and health is required to enhance adaptive capacity is required. Finally, beyond technical responses, access to ownership and control over productive assets, mainly land ownership and better access to community forests, by poor households can reduce their vulnerability to climate change.

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