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ARTICLE

Innovative Practices for the Promotion of Local/Indigenous Knowledge for Disaster Risk Reduction Management in Sudur Paschim Province, Nepal

Kabi Prasad Pokhrel[1*] Shambhu Prasad Khatiwada[1] Narayan Prasad Paudyal[1]
Keshav Raj Dhakal[1] Chhabi Lal Chidi[2] Narayan Prasad Timilsena[3] Dhana Krishna Mahat[4]

1.Central Department of Geography Education, Tribhuvan University, Kathmandu, Nepal
2.Central Department of Geography, Tribhuvan University, Kathmandu, Nepal
3.Central Department of Science Education, Tribhuvan University, Kathmandu, Nepal
4.PhD Research Scholar of Geography Education, Tribhuvan University, Kathmandu, Nepal

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ABSTRACT

This study is an attempt to point out the different types of natural hazards in Sudur Paschim province of Nepal where environmental degradation processes such as deforestation, desertification, biodiversity loss, soil crisp and watershed degradation are rising trends. Using participatory method multi hazard prone areas were identified with type and intensity. Multi criteria evaluation method was applied to prioritize replicable actions with location specific innovative practices and their legitimization for integrating local and indigenous knowledge into mainstream education, science and policy with a view to incorporate local and indigenous knowledge as live science in disaster and climate change education. Findings of the study reveal that varieties of natural hazards in combination with social factors such as poverty, conflict and inequality have resulted frequent disasters and social vulnerabilities in many parts of the province. Traditionally, indigenous and local people have responded threats of multi hazards by using their traditional knowledge and skills which has evolved over generations, and continue to adapt to future changes. These traditional, often faith-based, beliefs and practices were found to use as the key to their resilience in the face of natural hazards. However, many communities have been lost their knowledge as the elderly die without transferring it to younger members. Behind this proper educational policy and strategic development plans have not been implemented to cope local/indigenous knowledge into practices. Findings of the study indicate that indigenous and local knowledge is a precious province resource that can support the process of disaster prevention, preparedness and response in cost-effective disaster risk reduction. Therefore, policy framework has to prime focus to integrate indigenous and local knowledge, wisdom and skills into mainstream educational programs in order to transfer science into policy and education (words) into practice.

**Corresponding Author:*
Kabi Prasad Pokhrel,
Central Department of Geography Education, Tribhuvan University, Kathmandu, Nepal;
Email: drkabipokhrel@gmail.com
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1. Introduction

With more frequent and more intense disasters, disaster risk reduction (DRR) has become increasingly important as a fundamental approach to sustainable development. Indigenous communities have traditionally practiced their unique, innovative and location -specific novel activities for resource conservation, utilization and mitigation measures for disaster management. The practices of indigenous communities have widely used as local and location specific knowledge and wisdom in many areas of Hind Kush Himalaya like as the study area [1,2]. By adopting use-oriented approach to traditional knowledge and learning, indigenous knowledge has been considered as value of locals precisely and it has constantly tested and updated over time in spatial perspectives [3]. In this context local and indigenous knowledge system (INKS) holds a unique position in DRR discourse in often more vulnerable than non-indigenous groups and yet also hold location specific practices that enable a greater understanding of hazards and disasters. LINKS is in the wider debates on disaster policies, science and education as well as development agendas and singles to adopt DRR strategies through respect for local and indigenous approaches in coordinating alliances, culturally appropriate incentives, accurate, appropriate, and ethical data base, acknowledgment of local and indigenous land use practices; use of indigenous language, leadership, and institutions, collaboration with indigenous knowledge, and acceptance of traditional approaches [4,5]. The ability a community has to prepare itself for disaster preparedness and risk management need to be understood within the broader context of livelihood security, sustainability and building up community resilience in the long term [6].

The disaster management methods and practices have to link between local wisdom and scientific principles, strategies, and approaches and institutions such as conventions, government policies, strategies, rules and regulations that altogether govern interaction and integration with community building resilience and sustainable livelihood supporting ecosystems. It is, therefore, integration of indigenous and local knowledge system into disaster management methods and practices is a process of blending these knowledge systems into a rational decision-making, sharing of information and understanding of different viewpoints between the indigenous people and the western trained professionals [7,8]. Disaster management as being a mutual take and give back to nature for the benefit of all components of the supporting socio-economic system and ecosystem such duty is for each of the creation from the communities to the powerful political organization and the spirits [9,10,11].

The adopted Sendai Framework for Disaster Risk Reduction 2015-2030 also addresses knowledge-related issues and provides the opportunity to highlight the critical role of knowledge in disaster risk reduction. The framework encourages investment in innovation and technology development in disaster risk management. However, needs for science and technology inputs are unmet, and there is a lack of policy making that is based on science and evidence due to the issues like networking, coproduction of knowledge, and a stronger role played by academia searching innovative approaches and tools that could play game change role for DRR.

Local and indigenous knowledge needs to be integrated with science before it can be used in policies, education, and actions related to disaster risk reduction and climate change. Integration of local and indigenous knowledge to natural hazards and climate change with science can be developed through the process of observation, documentation, validation, and categorization of local and indigenous knowledge with a view to identify knowledge that can be integrated with science, which could then be further disseminated for use by scientists, practitioners and policy-makers, and safeguard and valorize those that cannot be scientifically explained in order to promote the use of local and indigenous knowledge to enable communities to increase their resilience against the impacts of climate change and disasters [12]. Thus, education has to be taken as an important component of disaster management for introducing disaster preparedness, prevention and response and information on predicting, preparing for, and responding to hazards have to be introduced in the curricula of schools and universities [13].

This paper tries to find out the best mitigation solution through study of past disasters in West Seti and Thuli gad watersheds and, effect of construction works in Siwalik foothills disasters such as landslides, soil erosion and drying of water sources in upstream and flash flood and river bank cutting in downstream of watersheds. Attempting main focus of the study, the paper further reflects the collective understanding and aspirations of people in the West Seti and Thuli gad watersheds so they can provide baseline information to help to identify hazard prone areas, mitigation measures and priorities for livelihoods improvements and supports the development of tools for watershed planning and approaches for collaborative management for the safer lives and better outcomes of the watersheds. Using political -ecological approach in the sense of citizen science, the main thrust of the paper was to initiate the efforts of community people including local government on indigenous and local knowledge develop-

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ment for disaster management. Thus, paper mainly concentrated to document local and indigenous knowledge and practices that are practiced by different communities to predict, mitigate and adapt to hazards in West Seti and Thuli gad watersheds of Sudur Paschim Province where natural hazards like landslides, floods, soil erosion, river bank cutting, debris flow, and seismic activities are frequently occurred .Further, the paper discussed the local heritage and traditions to mitigate and cope the issues climate change induced multi-hazards and socio-economic vulnerabilities. Through inventory of existing practices and their validating process, paper tried to establish their scientific basis for integrating them into science, education, policies, programs and projects for disaster risk reduction (DRR) and climate change adaptation (CCA).

2. Methods and Materials

The watershed area was delineated using GIS tools during the field observation stage. Using secondary literature and information biophysical conditions, socio-economic characteristics, infrastructure development stage, natural hazards, vulnerability and disaster risk, and bioresources related information were collected and share preliminary results to the multi stakeholders. Livelihood priorities, threats of hazards, vulnerabilities, and local resources values were identified by location and impact groups; and prepared plans for the key informant interviews (KII), and focus group discussions (FGD). Household (HH) surveys was conducted to assess the differential impacts of various natural hazards and environmental issues that effect on socio-economic life style of the residents of the watersheds whereas FGD for establishing the severity of natural hazards threats and significance values associated with local practices for mitigation of hazards and management of available resources; and KII to explore the causes and intensity of the particular hazards in the watersheds. Risk analysis proforma, guiding checklists designed around DRRM, local interest areas, cross cutting areas, were used while conducting surveys including governance, gender and social inclusion and policy.

The consolidated data collected through these methods were presented to group leaders at the exit sharing meeting to provide the participants with a share foundation for identifying and prioritizing DRRM issues in West Seti and Thuli gad watersheds. This was used to identify possible solutions and innovative practices for leveraging knowledge and support through partnerships with local communities, agencies and organizations. All total 380 HHs surveys were conducted in locations that were selected during the field study. The HH survey data were organized into four broad categories: a) natural hazards and vulnerability; b) livelihoods and well-being; c) mitigation measures and resource management practices; and d) promotion of local knowledge for DRRM and climate change adaptation (CCA). The surveys were conducted in locations that were selected using satellite image and meet with local representatives as participants indicated specific issues and challenges appropriate to their respective areas. The detail of the household survey is presented in Table 1.

Table 1. Household (HH) surveys by theme and number conducted

SN	Themes of HH survey	No. HH survey conducted	%
1	Natural hazards and vulnerability	105	27.63
2	Livelihoods and well-being	80	21.05
3	Mitigation measures and resource management practices	110	28.95
4	Promotion of local knowledge for DRRM &CCA	85	22.36
	Total	380	100.00

Source: Field study, 2021

To complement the surveys, we conducted 6 FGDs and 6 KIIs to investigate the key issues identified by households. Citizen scientists were mobilized for conceptualizing the local practices for DRRM and CCA.

Various hazard such as landslide, flood, debris flow and degraded lands were identified through the high resolution recent Google Earth images. Location and area were identified each of the hazard area in the selected municipalities. Among all derived hazard locations, only those areas were selected for field verification, which are more exposed to human settlements. Hazard prone settlements were identified through the location of settlements by near to and severity of the natural hazard. Field verifications were carried out to know the ground reality and their effect on local inhabitants. Reality of hazard and their effect on people were identified on the basis of discussion with local people and observation as well.

The assessment results that inform the collected issues were shared in the sharing meeting. The study team presented preliminary findings and asked the participants to rank these issues in order of importance as well identify as potential actions and outcomes that can be taken to address these issues. The participants were divided into groups to generate potential measures for the effective DRRM and the study team brought the various statements together and synthesized the ideas into the mitigation measures and adaptation strategies. Over all methodologi-

cal steps and processes are presented in Figure 1.

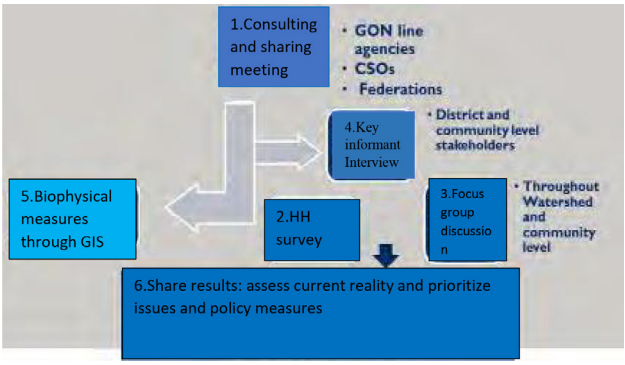

Figure 1. Adopted methodology of the study.

3. Study Area

The unique geo-tectonic, geological, geomorphologic and climatic conditions of these watersheds are vulnerable/susceptible to various kinds of natural hazards/disasters which have been compounded by increasing human interventions with the nature. Probability of debris flow, mass wasting, landslides, soil erosion, and river bank cutting in both watersheds is very high. In the geological overview, these watersheds occupy a position as harbinger between the Api Saipal and Chandy Himalaya with Karnali river system forming the divide. The rock types vary from highly metamorphosed schists and gneisses to shale and sandstone ranging in age from Middle Pre-Cambrian to Cretaceous. The rocks exposed in Upper Seti watershed belong to Dracula and Surkhet Groups ranging in age from Middle – Late Proterozoic to Lower-Middle Cambrian.

The West Seti watershed sits almost entirely inside Bajhang district with small parts extending into Doti and Bajura. The area is hilly and remote ranging in altitude from 3,400 m to just 750 m in the southern reaches. The spatial coverage of watershed is 1,488 sq.km and is administered by ten local governments organized according to the new federal structure. Most of the settlements in the watershed inhabit the plains along the Seti River Valley, between 750 m and 2,500 m. Within this range, two annual grain harvests are possible, depending on some geographical and environmental factors (e.g., sunlight, water availability, and soil fertility).

The landscape of the West Seti watershed is visualized into three interrelated themes that influence the dynamism of the watershed. They are nature (environment and natural resources), wealth (socioeconomics and infrastructure: the many ways that people use nature), and power (governance and institutions: the ways that the different people and groups make decisions together about the watershed and its uses) [14]. The analysis draws on multiple data sets associated with these themes to identify critical issues and in terms of its local natural and social dimensions. Then we examine how climate change and other drivers threaten and impact local livelihoods and biodiversity.

The West Seti watershed features a river system fed by rain and snow and comprised of both perennial and seasonal streams throughout. The watershed contains 151 rivers and streams, and several sub-watersheds with a total drainage density of 647m. The total drainage length of the watershed is 963 km, as the many rivers of the watershed run southward to the confluence with the Karnali River and eventually the Ganges Basin in India. At present Seti West Watershed is more vulnerable for landslides and soil erosion (Figure 2).

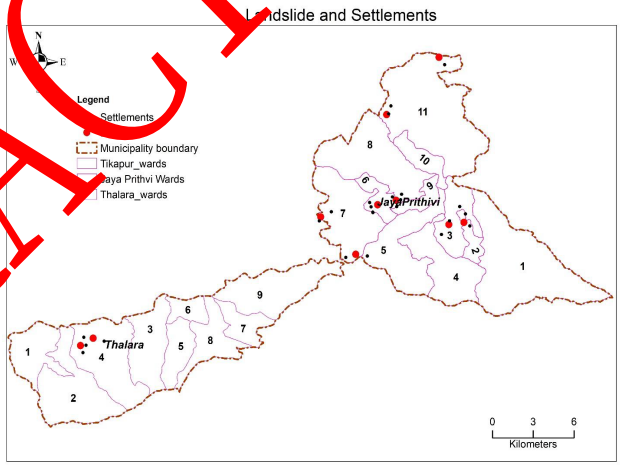

Figure 2. West Seti Watershed and Landslide at Badimalika, Bajura where 60 households were displaced after a landslide in July, 2020

The Thuli gad watershed is located within the Karnali River Basin that belongs to parts of Doti and Kailali districts. The watershed stretches across the Jorayal and Badikedar rural municipalities of Doti, and Mohanyal in Kailali. The total drainage density of this watershed is 935 m/km^3 and the total area of the watershed is 850 sq.km. Altogether 17 streams and 156 tributaries in this watershed flow into the Karnali River. Water drains from the north between the Karnaso gad of Doti through to the Khimadi near Mohanyal in the south from where it eventually flows into Karnali River (Figure 3&4).

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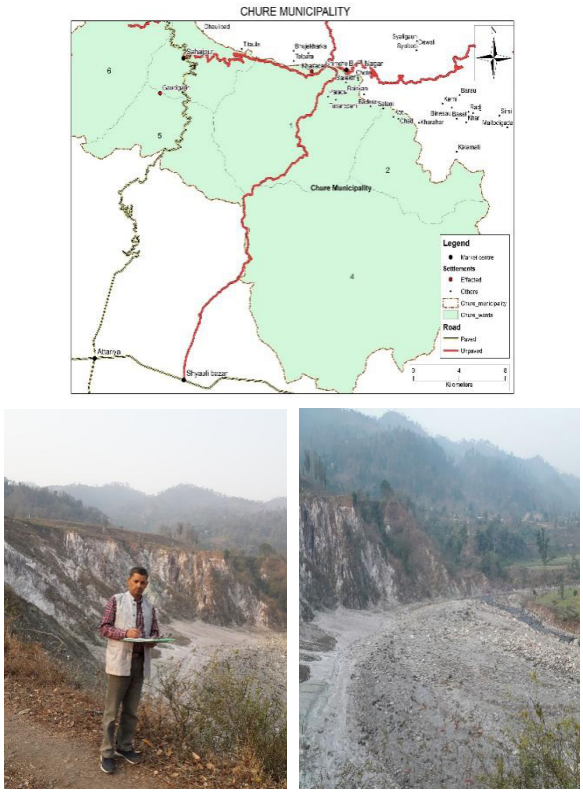

Figure 3. Big landslide and river bank cutting at Kimtala, Thuli gad Watershed where both settlement and cultivated land in high risk

Figure 4. Landslides and soil erosion at Thuli gad watershed

4. Resources and Hazards

Both watersheds are rich in biodiversity and agricultural land due to the altitudinal gradients in the watersheds, which have produced a wide range of ecosystems from north to south. However, resources like soil fertility and water for irrigation and drinking purposes reported continuously decline since decades. Around 53 percent of households reported having no sufficient water all year round. The overall climate of the watersheds is considered sub-tropical and temperate. At higher elevations, Chirr pine (Pinus roxburghii) trees and other broad leaf tree species predominate in the forests. At lower altitudes, Sal forest (Shorea robusta) is the dominant specie. Due to the steep topography of the watersheds, soil loss and soil fertility rate is observed high than national averages. Furthermore, the rising outmigration of men from the watershed means fewer human resources are available for agricultural work including soil management. Deforestation and shifting cultivation are two additional challenges to soil retention and fertility in both watersheds.

The design and construction of infrastructure, such as roads and hydropower plants, have an impact on the ecological health of the watersheds if appropriate preventive, mitigated and control measures are not adopted on time. For example, poorly designed rural roads on steep slopes can increase soil erosion and landslides in most of the rural areas of the watershed [15]. Similarly, hydropower plants that divert and impound water restrict the amount of water available for aquatic life that people depend on for their livelihoods. Irrigation canals, while bringing benefits to one group of farmers, can also reduce the amount of water available to other farmers. As demonstrated by these examples, it is important that the design, construction and operation of infrastructure projects account for the full range of social, economic, and environmental impacts within the watershed. Sustainable infrastructure should provide equitable distribution of benefits with minimal long-term, environmental impacts.

Regarding the land use pattern, there are four major types of land cover in the West Seti and Thuli gad watersheds more than 78 percent under forest, 19 percent under cultivated land, 2 percent under rivers and streams and rest portion under other wooded land and shrubs. Agriculture is the most common livelihood and out of total cultivable land around 37percent land dedicated to crops with 15 percent permanent irrigation) facility. Rice, maize, wheat and millets are the main cereals. Overall, we find decreasing river discharge during pre-monsoon, monsoon, and post-monsoon precipitation has decreased in these watersheds while temperatures have increased, and it is

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believed these are the two main drivers of the decreasing river discharge.

4.1 Availability of Drinking Water

In terms of social composition, the watersheds are widely varied in terms of ethnic origin, mostly Brahmin, Chhetri, Dalits, Magar, Lama, Bhote, Gurung, Newar, and Tamang. Major settlements are primarily composed of Brahman/Chhetri, Dalit, and Magar.

Household surveys conducted during march-April, 2021 (n=380) found that less than 65percent households obtain sufficient daily water within 30 minutes of home, while 15 percent require between 30-60 minutes, and 13 percent require more than an hour. Around seven percent families have private taps, therefore no travel is necessary for collection. Sixty percent households have access to piped tap systems followed by stream/river (11.2%), spout water (9.4%), uncovered well (10%) and rest others. The water supply for the piped systems comes primarily from springs (89.3%) while another 10.7% draw piped water directly from the river. In terms of water access, 82 percent of respondents said they had equal access to available sources while 18 percent said they did not have equal access. Ninety percent of water sources are public, and the rest are private.

4.2 Disasters and Social Vulnerability

During the field study an effort has been made to take the critical feedback and suggestions with the participants to identify priority issues and actions, and for promoting local practices on watershed management and disaster risk reduction. The representatives of elected local bodies also expressed eagerness to allocate their resources in support of activities in all aspects of watershed conservation and disaster risk reduction management. Most of the area of these two watersheds stretches from plains in the south to hilly areas in the center of the province. The watersheds have been faced many challenges, among them the construction of improperly designed roads and variability in climatic patterns. Table 2 summarizes the prioritized issues by the key informants and FGD participants in the area.

Table 2. Impacts of natural hazards by prioritized issues

SN	Prioritized issues	Impacts
I	Climate-induced hazards such as landslides, flooding and sand deposition	Loss or degradation of natural habitats reduces the number of natural resources available for local populations, such as declining fish populations and decreasing water availability. Landslides and flooding exact loss of property, infrastructure and human life.
II	Drying water sources	As water sources dry up, there is less water available for drinking, sanitation, and agriculture, and aquatic habitats are degraded. Additional investments are needed to improve water distribution and encourage adoption of modern technologies to improve efficiency of water use.
III	Flood and inundation	Flooding and sand deposition are the major threats to both human and ecological communities. Floods and landslides, further aggravated by the construction of improperly designed roads, pollute water bodies and damage natural habitats of freshwater biodiversity.
IV	Degradation of watershed resources	Watershed degradation leads to forest, water and soil quality decline and local community face the scarcity of livelihoods i.e., Food, Fuel and Fodder (F3) further leads outmigration from the watersheds.
V	Prolonged drought	Prolonged drought contributed to the drying up of springs and other water resources specially in Siwalik foothills in Jorayal and Badikedar Gaupalika in Doti and Mohanyal and Chure Gaupalika in Kailali. It was due to improperly constructed roads and climatic changes accelerate.
VI	Forest degradation and wildfires	Available timber and non-timber forest products decline, negatively affecting livelihoods and food security. Root systems that store water and stabilize slopes are weakened, increasing the likelihood of erosion and landslide. Risk of wildfires increases.

Source: Field study, 2021

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As reported by the stakeholders there are many climatic induced hazards both in West Seti and Thuli gad watersheds. At the same magnitude in Mahana watershed occurred last monsoon at Gundi, Chure Rural Municipality Ward-5 (Figure 5).

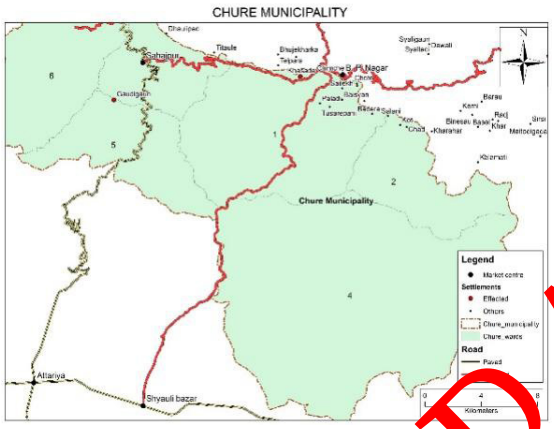

Figure 5. Landslide at Gundi, Chure-5

Figure 5 depicts the magnitude of Patreni landslide at Gundi Simal Gaira-5, Chure Rural Municipality which is located in Mohana watershed area. Big landslide incident occurred in July, 2020 and 25 households were displaced and took shelter in Chaumala. Ward chair reported that due to the sensitive area for landslide hazards more than 600 households had already left that area and resources need to settle them adopting integrated settlement development program in a safer area.

5. Perceived Mitigative Measures

Discussions with government officials, elected representatives, social and environmental activists and media persons as KII to suggest the remedy measures for rapid degradation of watershed resources, ever increasing natural hazards and growing challenges of livelihoods in Seti and Thuli gad watersheds, they suggested many preventives as well as mitigative measures for the effective disaster risk reduction management and sustainable management of watersheds resources. Most of the key informants stressed on government supports for local skills and techniques for retaining runoff water on site which will reduce erosion and protect agricultural land in upstream of the watersheds while FGD participants focused to encourage locally initiated and low-cost bioengineering and river bank management system and raise awareness to manage bushfire and open grazing through community users' groups by linking it with community livelihoods. However, elected representatives of municipal level as well as ward level viewed that need is to produce and disseminate communication materials and e-programs on best practices for disaster preparedness planning, disaster reduction, livelihood improvements, available herbal and aromatic as well as no-timber forest products (NTFPs) conservation, cultivation, processing and marketing for the long- term sustainability of local communities without any disasters. Government officials and I/NGOs representatives suggested to support for establishing and strengthening early warning system (EWS) at community level and improve implementation of environmental resource management plan (ERMP), disaster preparedness and response plan (DPRP) and local disaster risk. Personally, chairperson of Chure Rural Municipality pointed out that conservation of watersheds and wetlands is a prime task to reduce the multi-hazards like landslides, floods and soil erosion and strictly control and regulate extraction of river materials in upstream and downstream areas of watersheds.

Photograph 1. Discussion with Chairperson of Chure Rural Municipality at disaster management information center, Shivanagar-1

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Majority of the respondents further emphasized to relocate scattered and sensitive areas settlement in a safe location with modern facilities and construct shelter houses out of the floodplains and other vulnerable areas. They also suggested to improve implementation of water use master plans (WUMPs); implement low-cost techniques that stabilize slopes and riverbanks; adopt modern and simple technologies, such as solar water pumps, Dhiki pumps (treadle pump), drip irrigation, and rainwater harvesting.

The representatives of civil society and social activists including school teachers opined to encourage enforcement of existing laws and regulations related to watershed conservation and management, to conduct advocacy, training, and capacity building at the local level by including civil society (CS), community-based organizations (CBOs), community forest user groups (CFUGs), buffer zone management committees (BZMCs), and buffer zone community forest groups in creating plans for community resilience building (CRB). They further argued to initiate dialogues between and among the local province and federal government level agencies and between government and non-governmental agencies; promote ecotourism (e.g., sport fishing, rafting, and river beach programs), and promote local resource- based enterprises by providing adequate financial and technical supports to the local community for safety and wellbeing community life in disaster affected areas.

6. Innovative Practices for Disaster Reduction

As climate change induced natural hazards impacts continue to influence on resource degradation and socio-economic vulnerabilities in the West Setti and Thuli gad watersheds. Efforts made by governments and non-governmental organizations seem ineffective to anticipate and address these challenges at the community level. Government officials to water, forests and soils, several civil society organizations have been engaged to strengthen their livelihoods against threats of natural hazards and climatic variability. However, community lives are in high risk of multihazard and socio-economic vulnerability. The reason behind their inactive role in government led actions and programs is probably not to consider their traditions, knowledge and skills to reduce the risk of disasters and manage their livelihood resources. Thus, this study made an effort to cope their knowledge, ideas, skills and novel practices during the events of natural hazard and to document their innovative opinions for future planning strategies in the field of disaster risk reduction management and sustainable livelihood improvement in hazard prone areas. In response the local people in Jaya Prithvi Nagarpalika said that community resource plan needs to implement in disaster mitigation measures and integrate it with each infrastructure project undertaken in the future. They clarified that for every road built, the government should allocate money for earmarked and erosion control measures such as Gabion boxes. Similarly, In Chure Gaupalika, respondents opined that the infrastructure development budget has to cover construction-led disaster mitigation measures.

Whereas key informants in Sahajpur and Khanidada viewed that governance and its responsiveness has to towards community needs and aspirations for managing local resources sustainably, strengthening community resilience, and conserving biodiversity. Elected representatives of Badikedar Rural Municipality of Doti and Mohanyal Rural Municipality of Kailali emphasized on active participation of local communities in the planning process to mobilize the powers and functions relating to local level disaster preparedness and response planning, early warning systems, and distribution and coordination of relief material. But site observations and focus group discussions also revealed that almost all local government units i.e., urban municipality and rural municipality authorities have been executing these powers related to disaster management with less emphasis on conservation of resources, promotion of local skills and practices and enough resources have been devoted to construction works and relief (confronting objectives) distribution [16]. Though Constitution of Nepal provides local government authority to oversee management of forests, watersheds, wetlands, wildlife, birds, and bi-diversity. However, given the current transition to this federal structure, some of these rights and duties have yet to be exercised and discharged by the local governments [17].

Respondents expressed their growing awareness of the need to develop strong relations between upstream, middle-stream and downstream communities, and to understand the interconnection between upstream- downstream geomorphic process and events. They advised to sustainable conservation of upstream biophysical resources is a prime task to control downstream drought and flood hazards. Deforestation and destruction in highland due to unscientific road tract construction led to landslides, soil erosion in Chure range and steep hillslope area and consequently flash flood in low river basin. In spite of the many regulations providing working guidelines to promote local skills and technology for local resources conservation and utilization with low risk of hazards, there is a lack of implementation of community participation activities that lead to community initiations for safer lives and better outcomes [18].

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Respondents reported that coordination among local governments, district coordination committee, and province government is very low. Representation of women and marginalized community people also found low formal and informal committees, and organizations. Building consensus and ownership between government and local communities is the worst condition. However, the participants of FGD and Key informants in Thuli gad watershed stressed that coordination among communities and three-layer government is essential to create favorable condition for the resource conservation and promoting community resilience Stakeholders in both watersheds were asked to list their concerns about natural hazards, risk management and livelihoods. In response, stakeholders raised the issues of rapidly degradation of natural resources to support their livelihoods, devastating hazards like large scale landslides, huge amount of soil erosion, flash floods and droughts, growing unemployment trends and migration of youths in search of job and growing scarcity of daily life resources like water, forest and food grain production. Raised issues by stakeholders are summarized in Table 3 with their ranking.

After listing the issues related to scope, severity and local interest, participants were assigned to prioritize issues based on their perceptions of urgency in the need to address. Each participant was allowed to prioritize up to three issues, although many prioritized only two or one. Gender balanced was properly maintained to avoid the potential influence across gender. It(Gender case) was undertaken to collect the views and opinions about the local environments the severity of environmental degradation specifically from women and marginalized community people because women and marginalized community people have more dependency on environmental resources and they also highly affected by climate change induced disasters. The exercise revealed that local stakeholders have had significant concern for disaster risk reduction management, local initiations for available resource management, discouraging unscientific and unplanned construction works and improvement of community livelihoods by promoting local resource and technique-based entrepreneurship.

Regarding the local knowledge promotion for disaster management and sustainable livelihood improvement in multi-hazard prone area's communities, respondents suggested to develop inter-community and interinstitutional synergies and associations nationally as well as locally through academic and cultural collaborations. They viewed that such collaboration could facilitate both academic programs and local development agencies by the fusion of cultures and fostering minds through regional exchanges and cooperation in form of educational, research and development activities(19,20). This mechanism can promote a spirit of cultural awareness, adaptability and enhancing the transversal skills of its local people and academicians. To address the local, national

Table 3. Environmental issues by their rank

SN	Issues	Female	Male	Total	Ranking
1	Unplanned expansion of roads	4	20	24	Very high
2	Droughts and diminishing water	9	14	23	Very high
3	Degradation of wildlife habitats, decline in number and species of wildlife	9	8	17	Very high
4	Forest degradation due to open grazing and forest fires	2	12	14	Very high
5	Loss of agriculture due to landslides and river cutting	1	9	10	High
6	Unsustainable resin collection	5	7	12	Very high
7	Gravel mining and collection	6	10	16	Very High
8	Loss of property due to landslides	5	8	13	Very high
9	Threats to traditional livelihoods	6	5	11	Medium
10	Conflicts over water us	8	4	12	Medium
11	No collaboration between upstream and downstream communities	5	12	16	High
12	Unmanaged solid waste and drainage system	2	3	5	Low

Source: Field study, 2021

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and global challenges like environmental degradation, climate change, devastating disasters, poverty, inequality, peace and justice, practicable education program needs to implement from basic level to higher level to make safe, resilient and productive human community.

7. Conclusions

Climate induced natural hazards like landslides, drought and floods generated by extreme weather events and excess anthropogenic activities on fragile middle hells and Siwalik foothills which continue to have negative impacts on the people and economy of the province. The poor communities in the province are more affected and in vulnerable conditions due to the loss of their properties and compel to be displaced from the birth place in search of safe area for shelter and livelihood options. They are also lacking capital assets and other vital institutional support needed for their sustainable community lives in the area where disasters are rising on. Low levels of socio-economic life standard of these communities, the ongoing depletion of natural resources; lack of cultivated land and livestock raising; and inadequate financial services (in the form of microcredit, micro insurance and micro savings) limits their livelihood options and strategies. These communities are facing the disaster related life challenges and in unbearable conditions from every year occurred extreme weather events and natural hazards. Government initiations also appear insignificant level for disaster reduction and safety life of the affected communities in almost area of the province. This situation clearly appeals to implement measures that could build the capacity of communities by raise the awareness level and also empower them by enhancing capital asset accumulation, increase institutional support and the role of educational institutions for the effective disaster management local practices and climate change adaptation capacity building. Thus, all level governments need to provide required technical, financial, institutional and policy supports to make them safe from disasters and economic hardship. This can be achieved through policy formulation and action by the three level governments to provide the people access to technical skills, policy support and capital assets.

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