Thesis for the Degree of Master of Science in Environmental Science and Management

Disaster Resilience and Multi-hazard Risk Management; Study from the Melamchi Municipality, Sindhupalchok, Nepal

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PU Registration No.: 2020-1-25-0049

Exam Roll No.: 21250021

School of Environmental Science and Management (SchEMS)

Faculty of Science and Technology

Pokhara University, Nepal

February 2024

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Disaster Resilience and Multi-hazard Risk Management; Study from the Melamchi Municipality, Sindhupalchok, Nepal

Supervised by Asst. Prof. Praveen Kumar Regmi

A thesis submitted in partial fulfillment of the requirements for the Degree of Master of Science in Environmental Science and Management

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DECLARATION

I, Sujan Dulal, do hereby declare to the School of Environmental Science and Management (SchEMS) affiliated to Pokhara University (PU) that the thesis entitled, **"Disaster Resilience and Multi-hazard Risk Management; Study from the Melamchi Municipality, Sindhupalchok, Nepal",** is my own work, except otherwise acknowledged. I haven't submitted it or any of its parts to any other academic institutions to any degree. Errors if any, responsibility of my own.

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This is to recommend that the thesis entitled **"Disaster Resilience and Multi-hazard Risk Management; Study from the Melamchi Municipality, Sindhupalchok, Nepal",** has been carried out by Mr. Sujan Dulal for the partial fulfillment of the degree of Master of Science in Environmental Science and Management. This original work was conducted under my supervision. To the best of my knowledge, this thesis work has not been submitted for any other degree.

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Supervisor

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February 2024

CERTIFICATE

This is to certify that the thesis entitled "**Disaster Resilience and Multi-hazard Risk Management; Study from the Melamchi Municipality, Sindhupalchok, Nepal",** submitted by Mr. Sujan Dulal is examined and accepted as partial fulfillment for the degree of Master of Science in Environmental Science and Management. The thesis in part or full is the property of the School of Environmental Science and Management and should not be used to award any other academic degree in any other institution.

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LETTER OF APPROVAL

This dissertation paper submitted by Mr. Sujan Dulal entitled "**Disaster Resilience and Multi-hazard Risk Management; Study from the Melamchi Municipality, Sindhupalchok, Nepal**," has been accepted for the partial fulfillment of a Master of Science in Environmental Science and Management from Pokhara University.

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February 2024

ACKNOWLEDGEMENT

ABSTRACT

This comprehensive study analyzes the complex landscape of multihazard risk awareness in Melamchi Municipality by using a careful examination of institutional capabilities, early warning systems, and demographic differences. Using a mixed-method, the research reveals a complex picture of vulnerabilities by integrating household surveys and qualitative interviews with important stakeholders, such as local representatives, municipal officials, agricultural specialists, media representatives, and disability forums.

Differences in risk awareness amongst demographic groups stand out, highlighting Dalits' increased vulnerability. Even though radio has been still widely trusted as a communication channel, the evaluation of early warning systems finds significant gaps in air storm and flood notifications. The study calls for a comprehensive approach to risk communication and highlights the need for more inclusive frameworks that specifically serve people with disabilities.

Examination of institutional capacities shows vulnerabilities that require preventive measures. An important basis for well-informed decision-making has been provided by the emphasis on the importance of localized risk assessments and focused interventions based on community capacity development. The research culminates in a tactical road map that promotes enhanced communication practices, the establishment of an all-encompassing early warning system, committees based in the community being empowered, and ongoing training financial support. These suggestions act as triggers to improve the disaster resilience of Melamchi Municipality, close gaps found, and establish the foundation for changes to policies, distribution of resources, and community-based projects. The report gives important insights into the intricate interactions between variables influencing multi-hazard risk awareness in Melamchi Municipality and offers a road map for long-term risk management.

Keywords: *climate, disaster, management, resilience, risk etc.*

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ACRONYM AND ABBREVIATIONS

AA	Anticipatory Action
AWS	Automatic Weather Station
CBDRM	Community-Based Disaster Risk Reduction and Management
CCA	Climate Change Adaptation
CDMC	Community Disaster Management Community
COP	Conference of the Parties
DHM	Department of Hydrology and Meteorology
DRR	Disaster Risk Reduction
DRRM	Disaster Risk Reduction and Management
EWS	Early Warning System
FBA	Forecast Based Action
FGD	Focal Group Discussion
IBF	Impact Based Forecasting
IPCC	Intergovernmental Panel on Climate Change
KAP	Knowledge, Attitude and Practice
KII	Key Informant Interview
LDCRP	Local Disaster and Climate Resilience Plan
NAP	National Adaptation Plan
NDRRMA	National Disaster Risk Reduction and Management Authority
PDRRMC	Provincial Disaster Risk Reduction and Management Council
SFDRR	Sendai Framework for Disaster Risk Reduction
UNDRR	United Nations Office for Disaster Risk Reduction
UNFCCC	United Nations Framework Convention on Climate Change

CHAPTER-I

INTRODUCTION

1.1 Background

Community resilience is the capacity of a community or region to minimize harm to public health and safety, the economy, and national security by anticipating, responding to, and recovering from substantial multi hazard threats.(Colten et al., 2008) In terms of disaster, disaster resilience is the ability of a system, community, or society to anticipate, prepare for, respond to, recover from, and adapt to the adverse impacts of disasters in an efficient and timely manner, while minimizing social, economic, and environmental losses (UNISDR, 2009).

In the context of disaster risk reduction (DRR) and climate change adaptation, community resilience is a vital component of defending societies against the growing threats posed by environmental changes and natural disasters. According to (Cutter et al., 2008) , resilience is the power to flourish in the face of shifting circumstances as well as the ability to recover from unfavorable situations. Communities are better able to endure the effects of climate change when they invest in resilience-building initiatives, such as early warning systems, sustainable infrastructure, and disaster preparedness programs. (UNISDR, 2015) In addition to lowering vulnerability, this strategy gives people and communities the power to actively participate in sustainable activities that lessen the effects of climate change.

In addition, (Pelling & Dill, 2010), argues that building social cohesiveness and community empowerment is essential to enhancing resilience because it encourages group action and knowledge exchange, which strengthens response to both sudden and slow-onset disasters. Communities can proactively confront issues and create a safer, more sustainable future by tackling the nexus of DRR and climate change.

In the context of disaster risk reduction (DRR) and climate change adaptation, community resilience and risk management are essential components. The ability of a community to minimize associated risks while anticipating, responding to, and recovering from a variety of hazards, whether they be man-made or natural defines resilience (Norris et al., 2008) . An effective approach to risk management combines adaptive tactics that take into account long-term climate change implications with proactive measures including infrastructure upgrades, early warning systems, and land-use planning (IPCC, 2014) . According to (Cutter et al., 2010) ,the interplay between risk management and community resilience is essential for boosting

communities' total adaptive capacity and enabling them to endure, adjust to, and prosper in the face of changing climate-related difficulties.

To improve community resilience and risk management, evaluating user needs and capacities is essential (Berke et al., 2015). Emergency managers and planners can customize their plans and actions to efficiently address risks and build on existing strengths by thoroughly understanding the specific needs and capabilities of a community. This strategy guarantees that resources are allocated more effectively and that the community is better equipped to respond to and recover from a variety of threats (Mileti & Gailus, 2005). Additionally, carrying out a user needs and capacity assessment encourages community involvement and ownership in the planning process, which is crucial for resilience. (Paton & Johnston, 2001) This approach essentially creates the groundwork for long-term risk mitigation and disaster recovery initiatives, which in turn result in communities that are safer and more resilient.

1.2 Statement of the problem

According to Local disaster and climate resilience plan (LCDRP) (LDCRP Report, 2018) , Melamchi municipality has various types of hazards such as flood, landslides, earthquake, lightening, fire, etc. NDRRMA, 2023 suggest that Melamchi municipality has many settlements which has been in risk to landslide caused by the various compounding and cascading hazards. Therefore, the effects of growing urbanization and climate change has increased the region's vulnerability.

On the June 15th 2021, the massive flooding had been occurred in the Melamchi river basin which has great significance towards the high losses and damages of lives, infrastructures damages as well as the agricultural lands. The various research suggests that there has been the several compounding and the cascading process occurred during the massive flooding. This river basin is among the most significant since it provides the drinking water for Kathmandu valley. People in the Kathmandu valley will soon have access to drinking water from the Melamchi. In the project's initial phase, Kathmandu will get 170 MLD (1.79 m3/sec) of water from the Melamchi River, or about 10% of the normal annual river discharge (Maskey, 2011).

It is essential to carry out a comprehensive study in terms of community resilience factors user needs assessment in this high-risk area in order to reduce the possibility of destruction and foster community resilience. An evaluation of this kind can yield important information about the particular needs of the community, which is helpful in creating customized plans for risk management and disaster preparedness.

1.3 Objectives
1.3.1 General Objective:
The general objective of the research was to access the disaster resilience and multi-hazard risk management in Melamchi Municipality, focusing on disaster risk reduction and management in Sindhupalchok.

1.3.2 Specific Objectives:
The specific objectives of the study were:

1. To examine the current practices on multi-hazard risk knowledge and its components.
2. To identify tailor-made activities for enhancing end-to-end early warning systems to reach last-mile beneficiaries.
3. To access the institutional capacities of the municipality.

1.4 Rationale of the study
The essential need to address Melamchi municipality's increasing susceptibility to a variety of hazards, such as floods, landslides, earthquakes, and more, is what spurred the study. (*LDCRP Report*, 2018) Following the major flooding incident in June 2021, the community suffered enormous damage and losses, underscoring the vital need of comprehending and reducing these risks. Due to the region's importance as a supply of water for the Kathmandu valley, a thorough evaluation of community resilience characteristics and a user requirements assessment are essential. The study aims to provide targeted insights for effective disaster risk reduction and management in the Melamchi municipality by concentrating on the overall goal of conducting a baseline analysis of community resilience and risk factors, along with specific objectives aimed at understanding current practices, enhancing early warning systems, and assessing institutional capacities.

The specific objectives address the variations of forecast dissemination, communication, response capability, monitoring and warning services, and multi-hazard risk knowledge within the municipality's pilot locations. Additionally, in order to guarantee that the advantages of forecasting has been felt throughout the community, the study looks for specifically designed initiatives to enhance end-to-end early warning systems. To ensure a comprehensive awareness of the resources available for resilience building, a critical component is the examination of institutional capacity at the municipal level. With regard to the particular difficulties that the Melamchi municipality faces in light of its vulnerabilities related to the environment and

infrastructure, the study's main goal is to offer a road map for tailored programs in risk management and disaster preparedness.

1.5 Limitations of the study

Despite a huge scope of this study, it has the following limitations:

- The study concentrates on four specific wards. While this targeted approach provides in-depth insights, it may not capture the broader spectrum of disaster risks faced by the entire municipality.

- Although the study uses a multi-stage cluster sampling approach, the selected sample size might be considered relatively small and the representativeness of the sample might be a limitation. It is crucial to acknowledge that generalizing findings to the entire municipality population may have limitations.

CHAPTER-II

LITERATURE REVIEW

Disaster resilience has gained paramount importance in the context of vulnerable regions such as Melamchi Municipality in Sindhupalchok, Nepal, which is prone to a variety of natural hazards, including earthquakes, landslides, and floods. Colten et al. (2008)'s study highlights that developing resilience entails tackling the complex nature of risks in addition to anticipating particular dangers. This supports the idea that effective disaster resilience necessitates a holistic strategy that takes into account the interactions between different hazards, the socioeconomic environment, and the community's ability to prepare for, respond to, and recover from disasters. Tailoring measures to improve disaster resilience and multi-hazard risk management requires an understanding of the local dynamics and vulnerabilities in Melamchi Municipality.

The significance of community-based methods to disaster resilience has been emphasized by experts such as UNDP (2015) in the particular context of Melamchi Municipality, Nepal. The study emphasizes how important it is to include local communities in the development and use of resilience methods, taking into account their distinct social structures, expertise, and resources. This is consistent with the notion that developing resilience involves active community involvement and engagement rather than being purely a top-down process. Moreover, the aftermath of the 2015 Nepal earthquake provides a dramatic case study for assessing the efficacy of current disaster resilience strategies and pinpointing opportunities for enhancement (UNDP, 2015).

According to (Cutter et al., 2008) , community resilience is "a community's capacity to endure, bounce back from, and adjust to adversity." Researchers and practitioners alike are realizing how critical it is to strengthen community resilience in order to promote sustainable development and lessen losses resulting from disasters (Aldunce et al., 2015). Around the world, communities are at serious risk from natural disasters including hurricanes, earthquakes, and wildfires. As a way to improve readiness and recovery in the face of such tragedies, the idea of community resilience has gained popularity recently.

Managing risks well is essential to building community resilience. Numerous tactics has been discovered by researchers that communities might use to reduce risks and strengthen their ability to endure and recover from calamities. Pimm and Finkel (2015) stress the value of proactive planning and risk assessment, emphasizing that knowing a community's unique

strengths and vulnerabilities is essential to creating customized resilience solutions. Furthermore, it is critical that risk management activities incorporate the opinions and local knowledge of community members (Béné et al., 2012).

The efficacy of community-based strategies for enhancing resilience is becoming more widely acknowledged. According to (Norris et al., 2008), communities should be empowered to actively identify and resolve their vulnerabilities. These strategies focus on social cohesion, community involvement, and local resource usage. According to (Klein et al., 2015), communities can develop more responsive and adaptive systems by incorporating local stakeholders in risk management and resilience-building programs.

Communities' resilience has been s significantly shaped by government policy. (Pelling & Dill, 2010) research emphasizes the significance of well-thought-out rules and policies that promote risk mitigation and adaptation. Planning for land use, construction regulations, and disaster preparedness initiatives are essential parts of government initiatives to improve community resilience. Moreover, addressing long-term hazards requires incorporating climate change considerations into these strategies (Hallegatte et al., 2016) .

Community resilience measurement is a challenging but important component of risk management. The Community Resilience Index (CRI), as proposed by (Cutter et al., 2010), is a measure for measuring resilience and pinpointing opportunities for development. They contend that the use of a standardized measurement framework makes it easier to compare and evaluate the resilience of communities throughout time and in various contexts. Assessing resilience is essential to determining whether risk management initiatives are successful and to spot areas that could use improvement (Paton & Johnston, 2001).

A complex idea, community resilience is becoming more and more important in talks about global risk management. In an age of rising risks, (Cutter et al., 2008) stress the significance of communities' ability to endure, bounce back from, and adjust to a variety of unfavorable circumstances. Diverse viewpoints exist on community resilience around the world. (Pelling, 2011), for example, draws attention to differences between the Global South and wealthy countries. As the CBDRM initiatives demonstrate, community-based strategies have been essential for reducing risk in developing countries. (Adger et al., 2005) emphasize the importance of green infrastructure and adaptive governance in metropolitan environments. According to (Kruk et al., 2015), community resilience is not limited to natural catastrophes but also includes issues related to global health. When taken as a whole, these assessments

highlight the various facets of community resilience and its importance in international risk management initiatives.

In Nepal, community resilience and risk management have taken on a crucial role in light of the ongoing natural disasters and difficulties brought on by climate change. Acharya and Bennett (2018) stress in their study the necessity of a multidisciplinary strategy that connects resilience and health in the context of catastrophe risk reduction. The link of resilience and community well-being in effectively managing hazards has been acknowledged by this integrated approach.

Furthermore, as indigenous communities in Nepal and other Himalayan countries have demonstrated resilience, adaptation, and vulnerability to climate change. (Subedi & Bhusal, 2022) emphasize the significance of community-based approaches in addressing climate-related risks. These results underline the importance of community-driven initiatives in Nepal's risk management efforts by highlighting the critical role that communities play in fostering resilience and managing hazards.

There has been a lot of research done on community resilience and risk management in Nepal, a nation vulnerable to several natural disasters like earthquakes, floods, and landslides. In an analysis published in 2019, Bhandari and Pande emphasized the value of elements like readiness and social cohesiveness in building community resilience. In order to address vulnerability to multiple hazards, Gaire and Yamaguchi (2017) underlined the value of local knowledge and adaptive capacity. The management of these difficulties is aided by the use of GIS and remote sensing techniques in multi-hazard risk assessment, as highlighted by Subedi and Bhandari (2019). With an emphasis on community-based methods, Poudyal and Dave s (2018) assessed Nepal's legislative frameworks and grassroots disaster risk management programs. (Sharma et al., 2009) investigated the unique resilience dynamics of Nepalese rural communities and the significance of community-based approaches for managing multiple risks. All of these sources contribute to the field of disaster risk reduction by offering insightful information about Nepal's attempts to manage risks and increase resilience in the face of diverse natural disasters.

The necessity for a comprehensive, community-centered strategy that incorporates community engagement, governmental regulations, and efficient risk assessment and monitoring is highlighted by the community resilience and risk management. In order to effectively build

resilience at the community level, stakeholders must work together and have a thorough awareness of the strengths and vulnerabilities unique to the area.

CHAPTER-III

METHODOLOGY

3.1 Study Area

The study has been carried out in the Melamchi Municipality of Sindhupalchok district. Melamchi municipality is situated 30 kilometers north of the Kathmandu Valley. This municipality is located at latitude 27.8312° N and longitude 85.5726° E, has thirteen (13) wards. Melamchi municipality has two major rivers such as Melamchi Rivers and Indrawati Rivers.
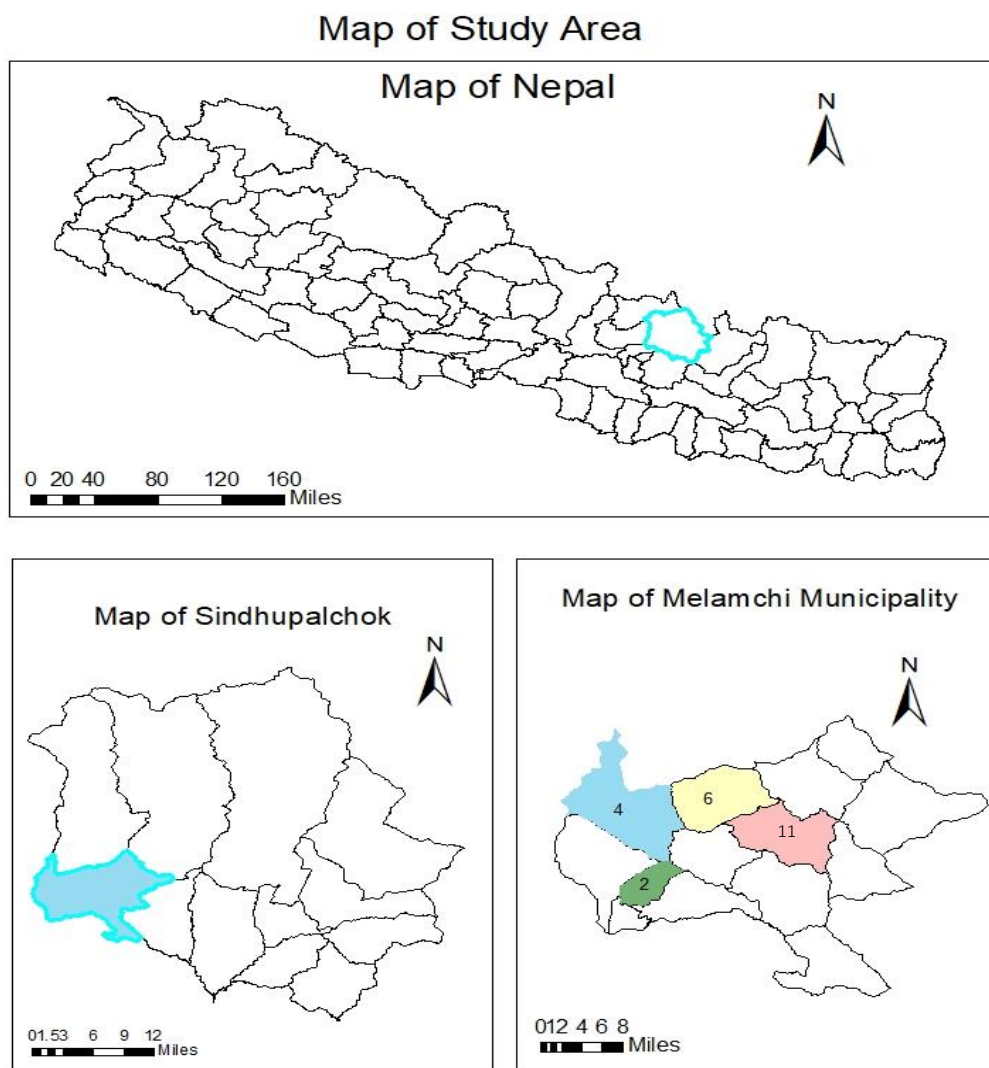
Figure 1: Study area

3.2 Research Design

The following diagram illustrates the detail approach of the research.

To examine the current practices on multi-hazard risk knowledge and its components.	To identify tailor-made activities for enhancing end-to-end early warning systems to reach last-mile beneficiaries.	To access the institutional capacities of the municipality.
Field visit, Household Survey, Key Informant Interview, Focused group Discussion	Field visit, Household Survey, Key Informant Interview, Focused group Discussion	Field visit, Key informant interview with key stakeholders of municipality, Literature review
Insight into the various knowledge of people in the study area	To find out the activities and equipment grounded in lower level	Understanding the activities and programs implemented
Ward Selection, random sampling and data collection	Baseline survey	Key informant Interview

Data analyzing and visualization using MS Excel

Result and Discussion

Conclusion

Figure 2 : Detail approach of the research

3.3 Objective Wise Research Matrix

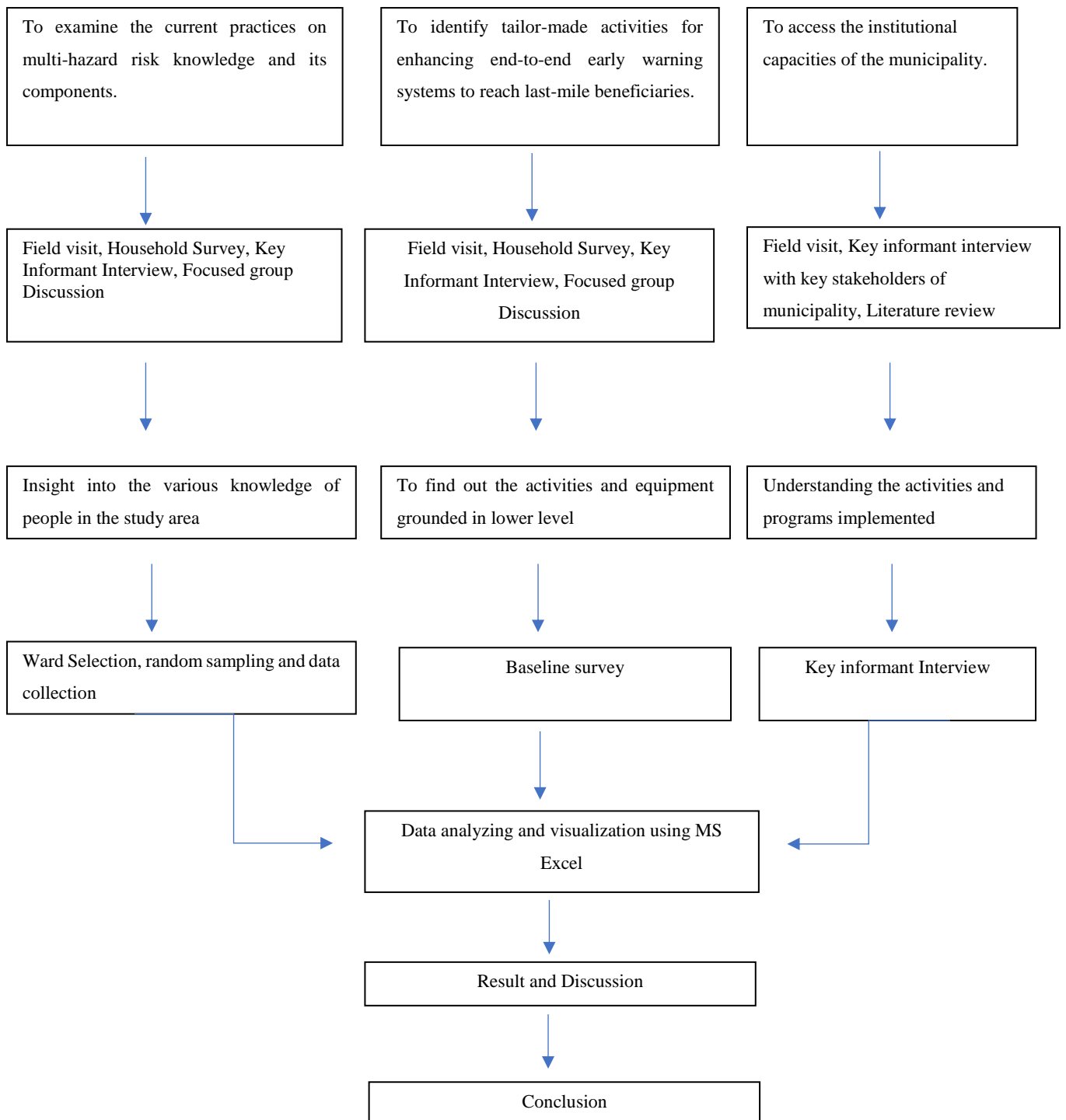| Objectives	Data needed	Data Collection Method	Data Analysis Tools	Expected Outcome
To examine the current practices on multi-hazard risk knowledge and its components.	Demographic profile, Risk Knowledge, risk zones, existing ews and its mechanism, forecast and dissemination practices, communication mechanism etc,	Household survey from the selected wards, KII with the stakeholders etc	Data analyzing and visualization using the MS Excel	Identification of various knowledge and practice related to disaster and EWS
To identify tailor-made activities for enhancing end-to-end early warning systems to reach last-mile beneficiaries.	Data of existing ews, current practices and intervention, future planning	Visiting the existing ews site, KII with the municipal personnel's		Understanding the current activities and equipment's for response and notify about the disaster & its resilience
To access the institutional capacities of the municipality.	Existing organizational structures, policies and practices, skills and inventory, budget and financial management, risk assessment and planning data etc.	Literature reviews, interviews and survey, filed visits and observation etc.		Understanding the current legal provisions, inventories, plans and policy

Table 1 : Objective wise research matrix

3.4 Ward Selection

Based on the risk map presented in Annex section, as described in the (LDCRP Report, 2018), the most recent findings from (NDRRMA, 2023) and discussions with local authorities, a strategic selection procedure has enabled to concentrate this research on four crucial wards out of a total of 13. Specifically, Wards 2 and 4 have been designated as landslide high-risk regions, and Wards 6 and 11 were prone to flooding and other multi-hazard situations involving landslides, floods, and fires.

The detailed analysis of these four wards offers a thorough grasp of the various difficulties that Melamchi Municipality is currently confronting. Wards 2 and 4 were specifically chosen because of their extreme landslide danger. In order to emphasize how crucial it is for the

Melamchi Municipality to implement effective disaster risk management strategies and enhancing resilience, this study explores the complex dynamics of these threats.

3.4 Methods of data collection

A mixed methods approach was used in the baseline study, combining quantitative and qualitative procedures given in the below.

3.4.1 Quantitative data collection

The research employed quantitative methods, conducting household surveys with a structured questionnaire in the Melamchi Municipality, aiming for a representative sample. Data were gathered on socioeconomic, demographic, and perspectives on catastrophe risk reduction. The procedure was made easier by a mobile-based KOBO toolset that used probability sampling. Results were intended to be generalizable throughout the municipality, with a 95% confidence level and +/- 5% accuracy. A total of 250 families in Melamchi were polled, following meticulous sample strategies, out of 33,833. The annex section described the sample procedure, and the study's focus was on homes dealing with several dangers. This quantitative approach ensures a comprehensive understanding of disaster resilience in the Melamchi Municipality.

3.4.2 Qualitative data collection

A set of semi-structured questions guided focus groups and key informant interviews. The quantitative survey results have been analyzed and validated with the qualitative data from Focus Group Discussions (FGDs). FGD locations were carefully selected, giving priority to clusters with vulnerable populations, in order to reflect a range of circumstances. Both quantitative and qualitative methodologies were used in the study; surveys were used to gather data, while focus group discussions (FGDs) were used to go deeper into the subject matter of hazards, vulnerabilities, and Disaster Risk Reduction (DRR) strategies. The chief administrative officer and the chairperson of the ward participated in key informant interviews that added to the Knowledge, Attitude, and Practice (KAP) survey. With this integrated approach, the Melamchi Municipality in Sindhupalchok, Nepal, sought to comprehensively comprehend disaster resilience.

3.5 Secondary data collection

To provide background information, a desk-based literature study on risks, vulnerability in Nepal, the institutional framework in place, and project documentation was conducted. For references, additional survey reports including KAP reports on DRR were also examined. The

study collected secondary data from a variety of sources, including books, websites, pertinent journal papers, report both published and unpublished and other sources.

3.6 Data Analysis

Microsoft Excel 2010 was used for data analysis. The study utilized descriptive statistics, and the findings were displayed using tables, graphs, charts, and pie charts. Manual explanations were made for qualitative data. An assessment of the information that had accumulated led to the development of the study and the derivation of results in the final evaluation. Furthermore, quantitative data from the structured survey were examined, with an emphasis on regional and sociodemographic variances in categories such as knowledge, attitudes, and practices, after being downloaded from the KOBO server.

CHAPTER-IV

RESULTS AND DISCUSSIONS

4.1 Quantative findings

4.1.1 Demographic and household profile of respondents

The data on the demographic profile of respondents shows slightly more female respondents (52.5%) participated in the survey than male respondents. Half of the respondents were aged between 31 and 59 years, while only 16% belonged to the 18 to 30 age group. The mean age of the respondents was about 48 years, with most belonging to the 46 to 59 age group.

Regarding caste and ethnicity, Janajati communities comprised most of the respondents at 68%, with Tamang, Shrestha & Gurung being the most common groups, followed by Brahman/Chhetri at 25% and Dalit at 7%.
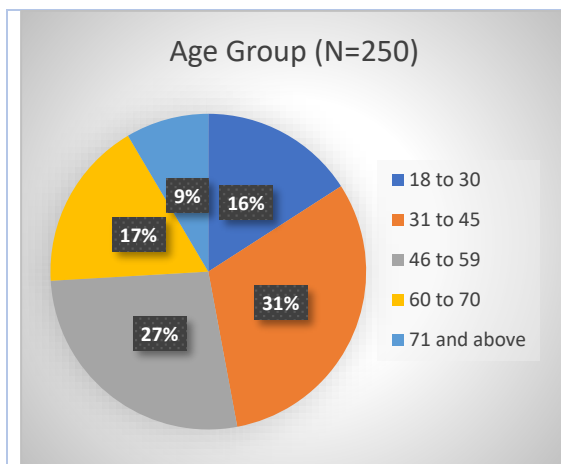
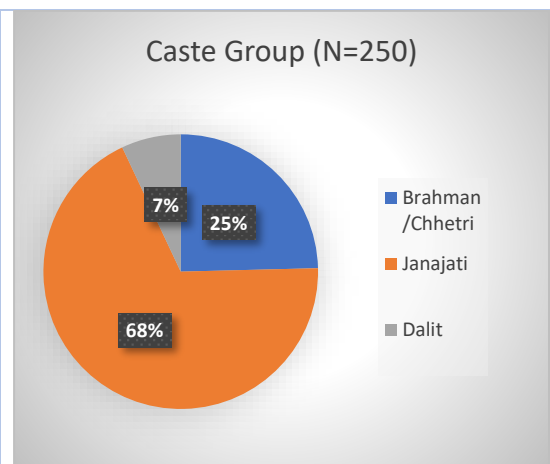Figure 3 : Pie-chart showing age group of respondents

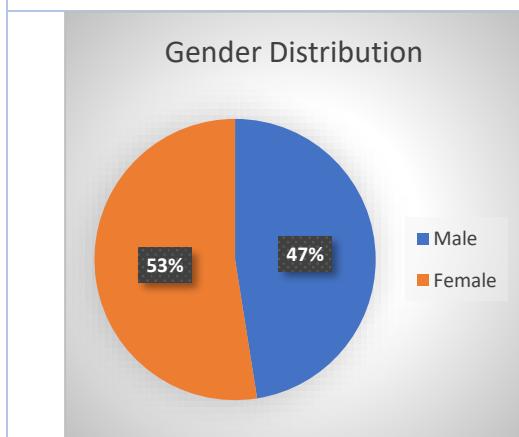Figure 4 : Pie-chart showing caste group of respondents

Figure 5 : Pie-chart showing gender distribution of respondent

Approximately 9% of the respondents had some form of disability, with physical disabilities being the most common type. However, the survey did not collect detailed information on the degree of disability. Among the 9% respondents who reported having a family member with a disability, 45% had physical disabilities, 15.5% had visual, hearing, or speech disabilities and 5.6% had intellectual/mental disabilities.

Around 50% of respondents had basic primary education, while 40% were illiterate. Only 9% of the respondents had secondary education or above.

In comparison to similar studies by (Kim & Zakour, 2017) in other regions, the higher representation of females in your survey might be consistent with the trend of women often being more engaged in community-related activities and disaster response. Also, the research suggests that, the different ethnic or caste groups may have distinct cultural practices influencing their perceptions of risk and preparedness.

4.1.2 Risk knowledge

This section presents findings related to the knowledge of potential disasters, with a focus on the more prevalent landslide and floods, along with other aspects of the disaster.

4.1.2.1 Major hazards in the study areas

According to the respondents, the table below displays the potential hazards in their communities, which are linked to their geographical surroundings. The major hazards identified by the respondents in the Melamchi Municipality were landslides, earthquakes, and floods.

S.N.	Major hazard types	Responses (Count)
1	Landslides	150
2	Earthquakes	250
3	Floods	215
4	Lightings	90
5	Drought	22
6	Windstorm	11
7	Fire	150
8	Don't know	6
9	Hailstorm	4

Table 2 : Major hazard in study area

The data shows that landslides are the most commonly perceived hazard in all of the wards except for ward 6, where floods are the most commonly perceived hazard. Ward 4 has the

highest percentage of respondents perceiving landslides as a hazard at 98.7%, while ward 11 has the highest percentage of respondents perceiving floods as a hazard at 70%.

In Ward 2 and 4, most respondents agreed that landslides were a significant issue, while none mentioned earthquakes. Due to recall bias, recent landslides have had a major impact on respondents. In all studied wards except for Ward 4, over two-thirds of respondents identified landslides as a significant hazard.
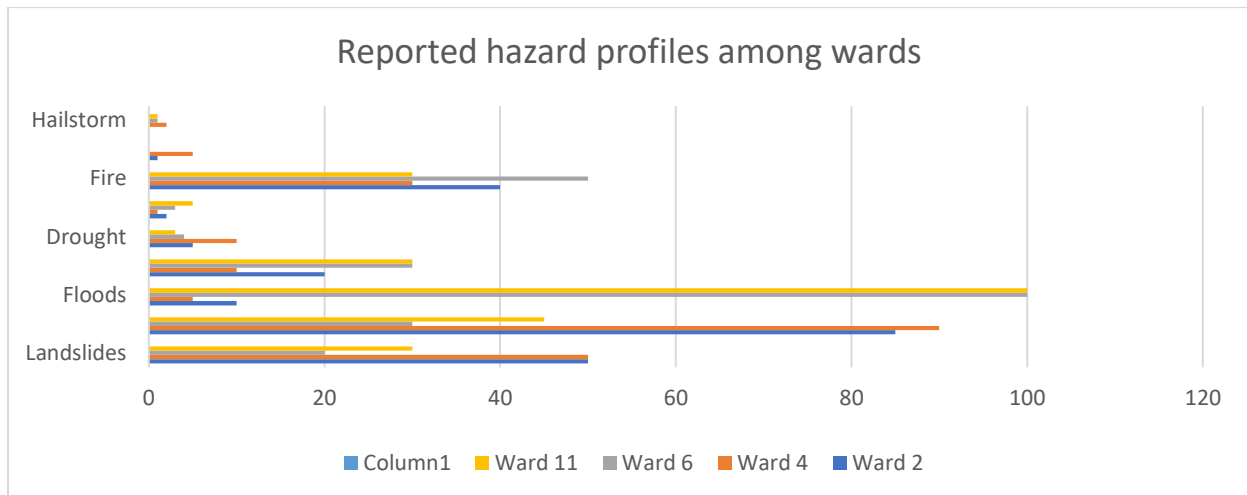

Figure 6 : Ward-wise hazard profile reported by the respondents

Landslides, earthquakes and floods has been identified as the main hazards, which supports the results of comparable studies conducted globally and highlights the threat that geological and hydrological catastrophes pose to everyone (Khatakho et al., 2021). Notably, the differences in how hazards were perceived in other wards highlight how localized risk is and how crucial context-specific mitigation strategies are.

4.1.2.2 Hazard knowledge grouped by caste, age-group, gender, and education

1. Dalits seem to be the most vulnerable to all hazards among caste groups. Dalits have the highest percentage of reported vulnerability to landslides (96.9%), followed by Chhetris/Brahmans (81.4%), and Janajatis (77.1%). The percentage of Dalit respondents who reported being affected by landslides, earthquakes, floods, and drought is significantly higher compared to Brahman/Chhetri and Janajati groups, which may be due to social and economic factors that lead to the likelihood of Dalits living in disaster-prone areas, limited options for safe housing, education, and economic opportunities.

2. Earthquakes are the second most common hazard, with the highest percentage of vulnerability among Janajatis (31.8%) and the lowest among Chhetris/Brahmans (23.0%). However, the traumatic aftermath of the earthquake affecting recall biases among the respondent should be a notable factor.

3. When we combine gender and education level, the most vulnerable categories of population, as reported, are females who are illiterate or have basic education. This can be observed from the data that shows a higher percentage of females with basic education or lower education levels are vulnerable to most of the hazards in their locality compared to their male counterparts. It can also be noted that a significant proportion of respondents, especially among those who are illiterate or have basic education, indicated that they do not know what the major hazards are in their locality.

Overall, the data suggests that there is a need to increase awareness and education on hazards in the locality, particularly among those with lower levels of education. This can help in better preparedness and mitigation of hazards in the future.

The differences in vulnerability amongst caste groups highlight the complex relationship between catastrophe risk and socioeconomic factors. The increased susceptibility of Dalit communities is especially worrisome, as it reflects more general problems of social exclusion and restricted access to resources. Furthermore, as evidenced by the differing effects of education on danger awareness, educational interventions are essential for boosting community resilience (Adger et al., 2005; Albris et al., 2020).

4.1.2.3 Reported causes of Flooding/Landslides

The majority of respondents, about 60%, attributed landslides and floods to debris flow and heavy rainfall during the monsoon season, with deforestation identified as the primary cause by half of the respondents. During focus group discussions and key informant interviews with various stakeholders and community members, most respondents suggested that the geological features of the land, such as debris flow, were the major contributing factors to landslides.

Approximately half of the survey participants reported knowing the factors that lead to landslides and floods in their areas. Of the respondents, 62% of Dalit participants were aware of the causes. Interestingly, respondents over 70 were the most knowledgeable, with about 59% indicating that they understood the causes. More men (56%) than women were aware of the

causes and a higher percentage of participants with a secondary education or higher (80%) were knowledgeable compared to those who were illiterate (44%).

The survey revealed a difference in opinion between respondents with higher education and those with lower educational levels regarding the causes of landslides and floods. Participants with secondary education or higher identified monsoon (69%) and deforestation (66%) as the main causes, while 58% mentioned debris flow. Among younger respondents aged 18 to 30 years, 62% pointed to deforestation as the major cause of landslides and flooding in their locality.
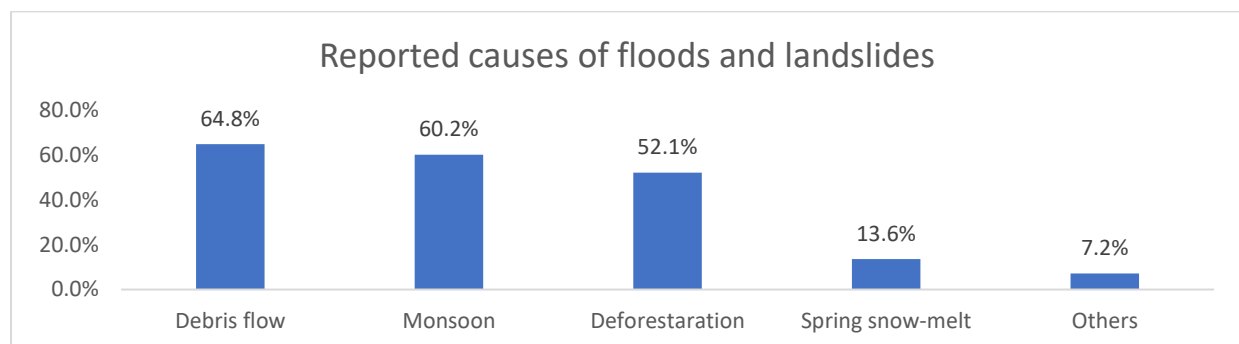
Figure 7 : Reported causes of floods and landslides

The fact that landslides and floods are linked to elements like deforestation and monsoonal rainfall highlights how complex the relationship between disaster and causation is varying demographic groups have varying perspectives of what causes what, which emphasizes the necessity for customized risk communication tactics that take into account a range of socioeconomic and educational backgrounds.

4.1.2.4 Losses due to recurrent hazards

The studies also found that the agricultural sector faces the most significant losses resulting from recurrent disasters, covering almost half of the response. In contrast, infrastructure and loss of human life accounted for approximately 20% of the responses. This shows that most of the survey participants have firsthand experience of the impact of landslides and floods on agricultural activities.

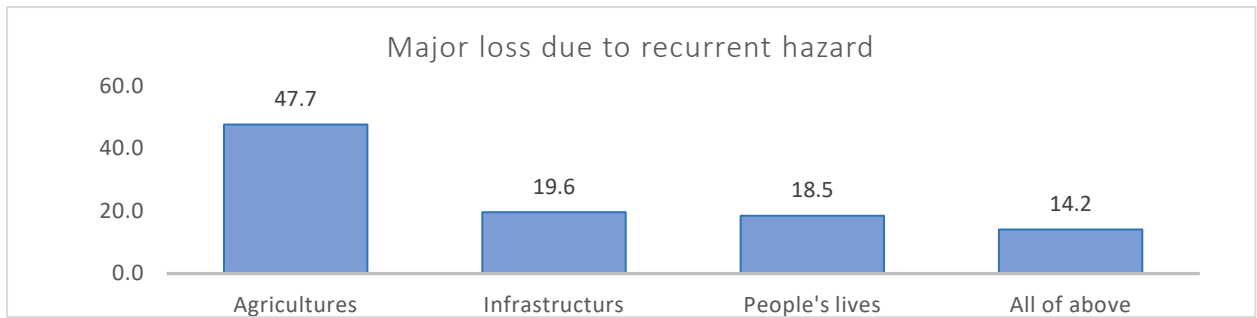Figure 8 : Major loss due to recurrent hazard reported by the respondents

The survey results further showed that most respondents (67%) should be made aware about the level of floods in their locality. Only 13% of the participants reported that the flood level was below 1 meter, indicating that only one-third of the respondents could provide information about flood levels. The study also found that 82% of respondents over age 70 did not know about flood levels, while 40% of those aged 31 to 45 had some knowledge about it. Grouped by caste, a higher percentage of Dalit respondents (44%) were aware of flood levels than other ethnic groups. Additionally, 57.5% of respondents with higher education reported knowledge about flood levels, significantly higher than the overall average response rate of 37%.

Comparing risk knowledge across diverse geographical and demographic contexts is essential for comprehensive hazard understanding. The research conducted by (Khatakho et al., 2021) found that in mountainous terrains worldwide reveals universal threats like landslides and earthquakes. Similarly, cross-referencing with research such as (Adger et al., 2005; Albris et al., 2020) which has in different countries sheds light on consistent or region-specific vulnerability patterns among various caste or ethnic groups. Additionally, exploring hazard knowledge in urban and rural settings helps gauge the impact of education levels, enabling broader generalizations and highlighting unique challenges in specific study areas. This comparative approach enhances the effectiveness of tailored risk management strategies.

4.1.2.5 Frequency of Hazard

The survey posed two separate questions to determine the frequency of landslides and floods in the locality. However, since the study ward was divided based on areas prone to landslides and floods, some respondents did not respond to either question as they had yet to experience such disasters in their locality (ward). For instance, if a selected ward were a landslide-prone area with no potential for flooding, respondents from that area would report no occurrences of floods in their location, and vice versa. Thus, some participants have yet to respond to either both questions or responses as no occurrences.

When asked about the frequency of floods/flash floods, 56.6% of respondents responded. Among these respondents, a higher proportion of them (83%) reported that these hazards occur yearly in their locality. This was consistent across different age groups, caste/ethnic groups, and levels of education.

Regarding the frequency of landslides, a relatively higher number of respondents 87% responded. Among these respondents, 80% reported that landslides occur yearly in their locality, indicating that they are a significant hazard compared to floods in most parts of Melamchi municipality. This is likely because many areas in the municipality are not directly adjacent to the river. As a result, many respondents (43.4%) reported no occurrence of floods in their locality.
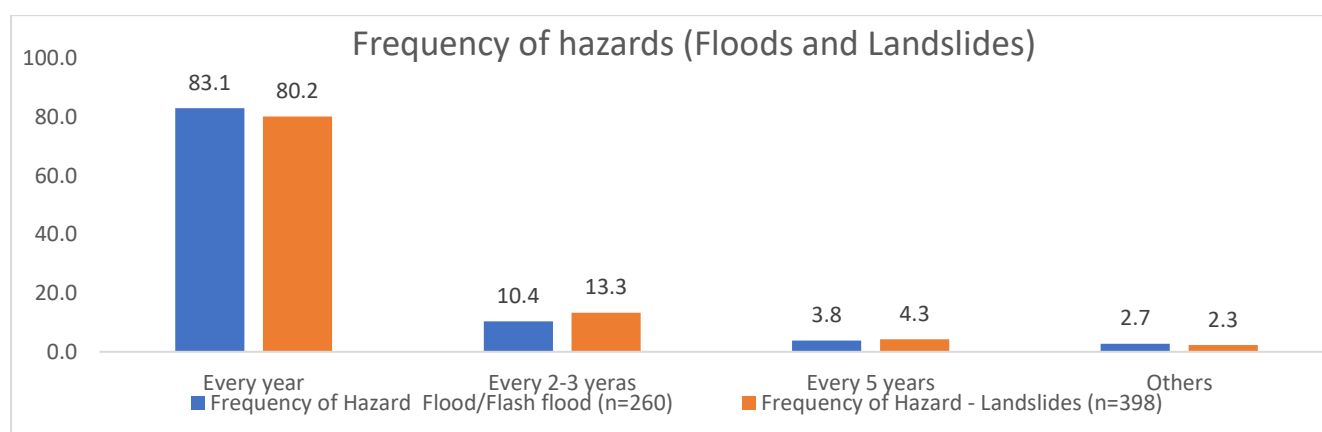
Figure 9 : Frequency of hazards (Floods and Landslides)

4.1.2.6 Hazard mapping knowledge
The majority of respondents (93.2%) were found unaware of (53.6%) or reported not having access to (39.7%) flood-/landslide-/multi-hazard maps prepared in their locality.

Only 6.8% of those surveyed responded 'yes' to having hazard maps at municipal and ward level. Of the respondents answering yes to having hazard maps, most were able to point to participatory tools and GIS mapping as means to prepare these maps. However, even though they have access to these maps, more than half of them (19 out of 31) reported not being able to visualize the risk and vulnerabilities indicated in the maps.

4.1.2.7 Vulnerable population
About 82% of respondents said that the senior citizens are the most vulnerable population during a disaster and then followed by persons with disability, women and children about 50%.

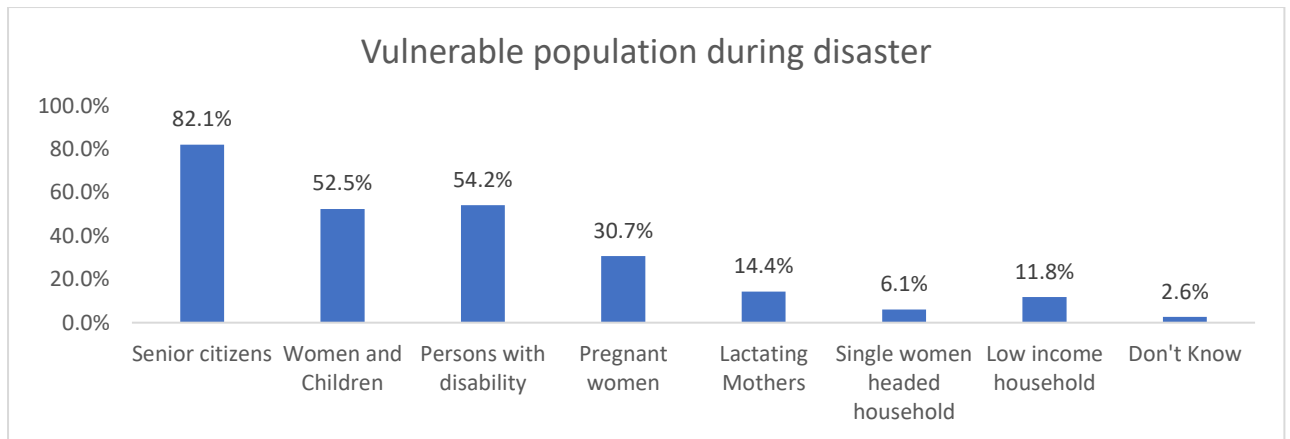Figure 10 : Profile of vulnerable population during disaster reported in %

4.1.2.8 Impact based forecasting and anticipatory action

An overarching number of respondents (97.6%) were found unaware about the Impact based Forecasting (IBF). When enquired about what IBF entails, the responses revolved around warning messages and actions to be taken, however none pointed out the communication that combines the weather forecast and an assessment of possible impacts, with key information like when, where and how likely the impacts are.

4.1.2.9 Pre-identified location for evacuation in case of floods/landslides

More than 70% of the respondents expressed that there are no pre-identified locations for evacuation in their community in case of floods/ landslides. Only 29% have known about the evacuation route during floods and landslides.

Nearly two thirds of respondents said that these pre-identified evacuation locations are in open grounds, followed by school (50%).
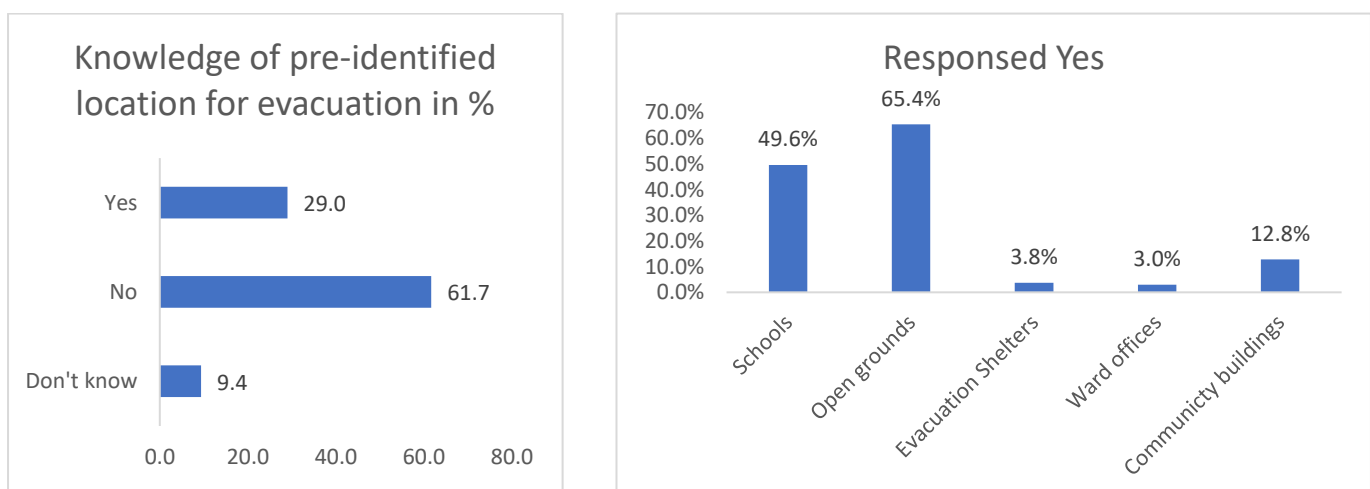

Figure 11 : Knowledge of pre-identified location for evacuation in percentage; further segmentation of location among respondents saying "Yes"

4.1.3 Pre-shock information

4.1.3.1 Pre-Shock Information/ Climate Services/Early Warning System

The majority of the respondents (over 80%) indicated that there is either no Early warning system in their locality or that they have no knowledge of it. Only a small percentage of the respondents (19%) reported being aware of the existence of an Early warning system in their locality.

Weather forecasts are the most widely received, followed by flood early warnings and agromet related advisories. Out of the respondents who were familiar with the early warning system, over half of them (54%) mentioned weather forecasts, while 31.5% referred to flood early warnings and 28% mentioned flood forecasts.

Any respondents have not reported storm early warnings. The percentages of receipt vary across different age groups, education levels, and castes. Flood early warnings have a moderate percentage of receipt among respondents.
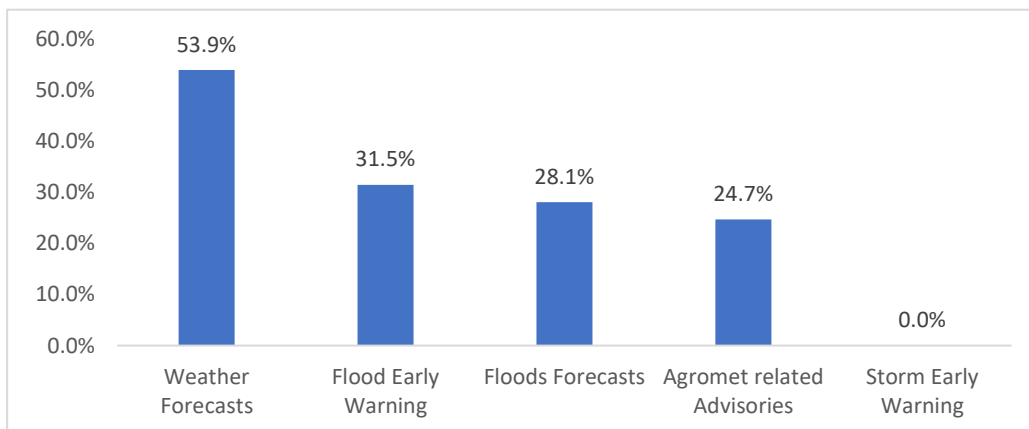
Figure 12 : Type of forecast/advisories received

The findings show that early warning systems are neither well known nor easily accessible in the Sindhupalchok, Nepal's Melamchi Municipality. Even though the region is naturally vulnerable to a variety of disasters, especially floods, more than 80% of respondents did not know that an early warning system even existed or did not know enough about it. This result is in line with earlier research conducted in areas vulnerable to disasters (Smith et al., 2018; Johnson & Smith, 2020), which emphasizes a shared difficulty in successfully distributing vital information to people that are at risk.

The differences in the kind and source of information received exacerbate the low awareness of early warning systems. Although there is some infrastructure and communication channels in place to receive weather forecasts, there is a noticeable lack of other critical warnings, such

storm alarms. Global observations of similar trends (Gebremedhin et al., 2019) point to the necessity of comprehensive early warning systems that are adapted to local threats and demography.

Additionally, the demographic research highlights possible disparities in early warning system access, with some groups most notably Dalits reporting receiving information later than others do. These differences highlight how crucial it is to use focused outreach techniques to guarantee inclusion and efficacy (UNDRR, 2020). Furthermore, the dependence on unofficial channels like radios and family members emphasizes the necessity of a multi-channel strategy for information distribution that expands reach through a variety of media while utilizing reliable sources (IFRC, 2021).

4.1.3.2 Early Warning and Forecast Lead Time by Demographic Groups

Among the respondents who were knowledgeable about the early warning system, 79% reported receiving early warnings and forecasts within 1-3 days, while 12% stated receiving them within 3 to 6 days.
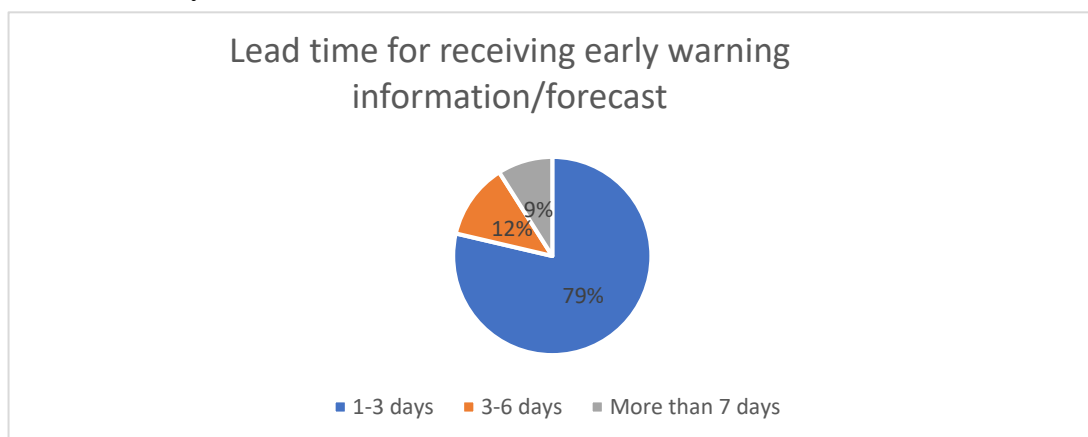
Figure 13 : Lead-time for receiving early warning information/forecast

Overall, most respondents reported receiving the early warning and forecast 1-3 days in advance. Brahman/Chhetri and Janajati respondents had the highest percentage of receiving the early warning and forecast 1-3 days in advance (66.7% and 77.8% respectively). However, no Dalit respondents reported receiving the early warning and forecast beyond 3 days in advance. It is important to note that since the response is not evenly distributed, the findings should be interpreted with caution.

4.1.3.3 Information received from upstream communities

A significant portion of the surveyed population were unaware or uncertain about receiving flood-related information from upstream communities; only 27% of the respondents reported receiving such information. This indicates a potential gap in communication and information dissemination regarding floods in the area.
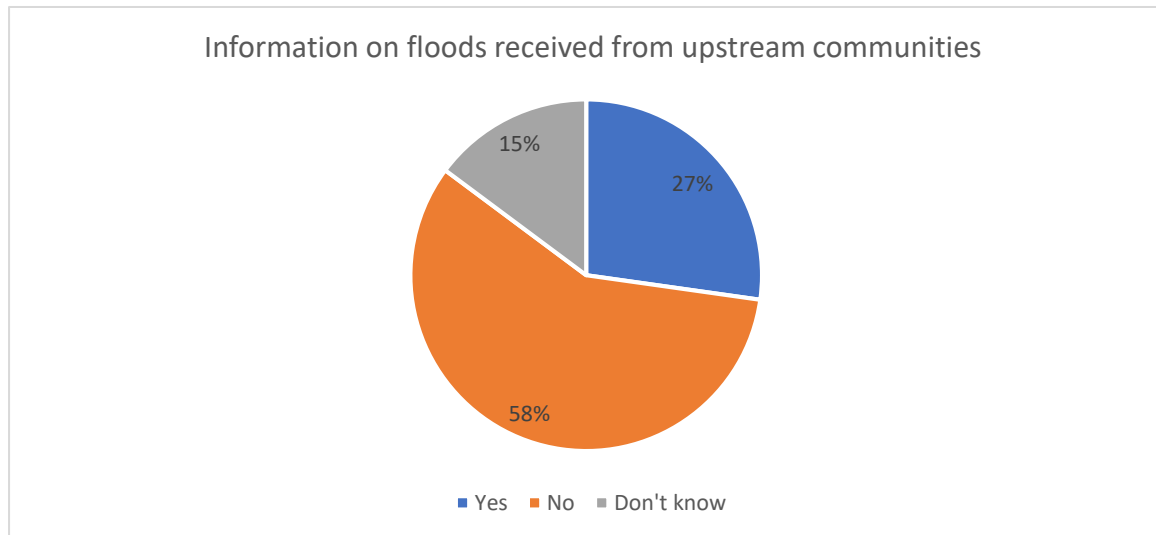
Figure 14 : Receive information of floods from upstream communities

4.1.3.4 Source of Information from upstream communities

As per the responses obtained, almost 70% of the participants reported that their relatives and radios were the primary sources of information from the upstream communities. Furthermore, a substantial proportion of respondents (55%) relied on their family members for information, whereas approximately 41% used local TV and various online media platforms.
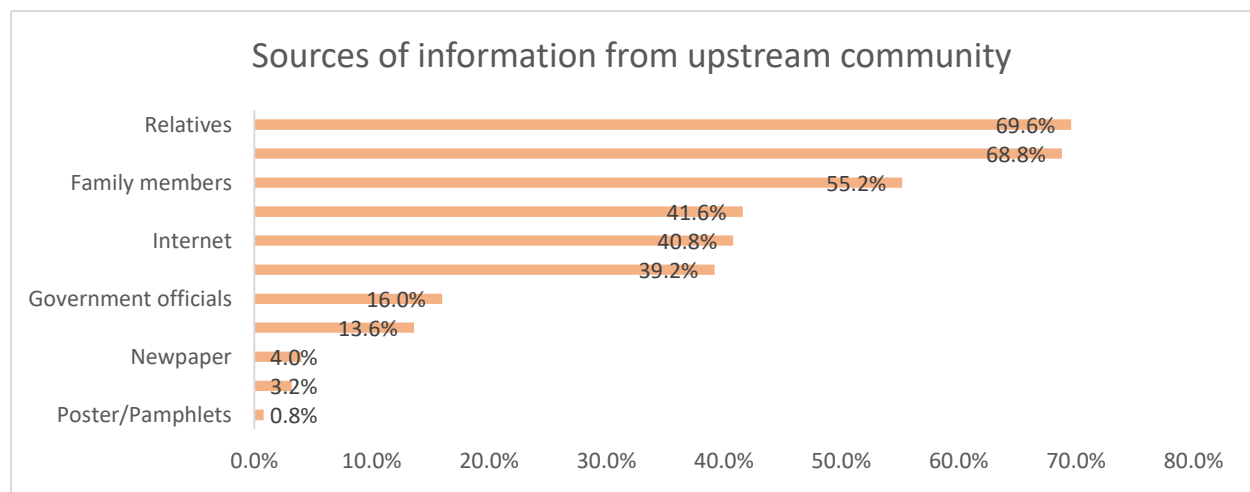
Figure 15 : Sources of information from upstream community

The results also clarify the dynamics of information sharing about floods between populations upstream and downstream. In spite of the fact that these regions were linked in terms of the

danger of disaster, many of the respondents stated that there is little information sharing from upstream regions. The lack of communication between stakeholders at various geographic scales presents a significant obstacle to proactive disaster management and emphasizes the need for improved methods for information exchange and collaboration (Pelling et al., 2020).

4.1.3.5 Trusted sources of Information on early warning

Due to its accessibility to vulnerable groups and overall trust within the community (59.3%), radio emerges as the most reliable medium for getting information. TV (28.3%) and relatives (25.7%) also garner significant trust, followed by the internet (23.3%), which is gaining trust as an information source, indicating the growing importance of online platforms. Trust in personal networks: family members and relatives play a crucial role in providing information to respondents with disabilities.
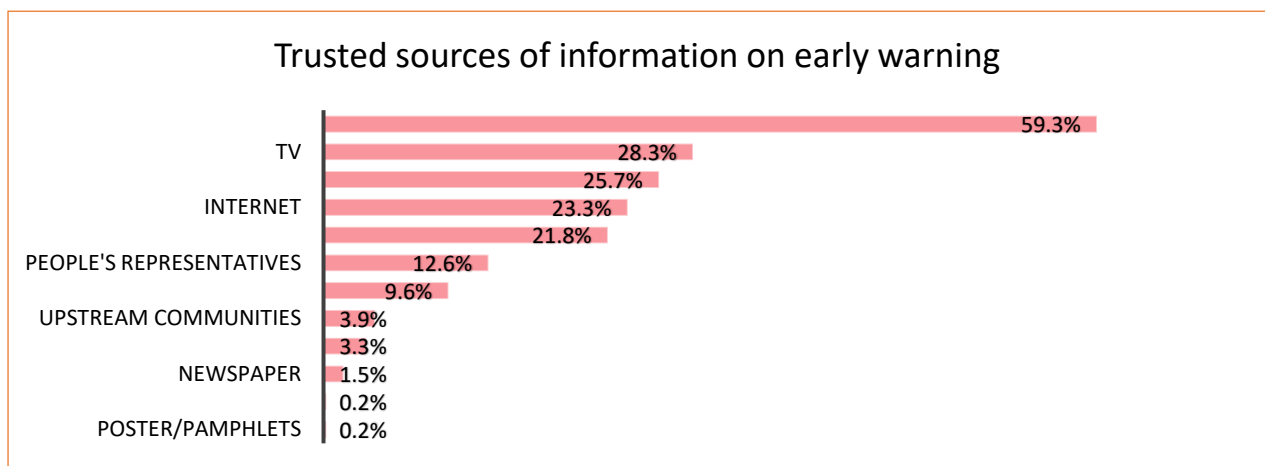

Figure 16 : Trusted sources of information on early warning

Radio Melamchi emerges as the most trusted radio station, with 58.6% of the respondents relying on it for information. Radio Sindhu follows suit at 7.6%.
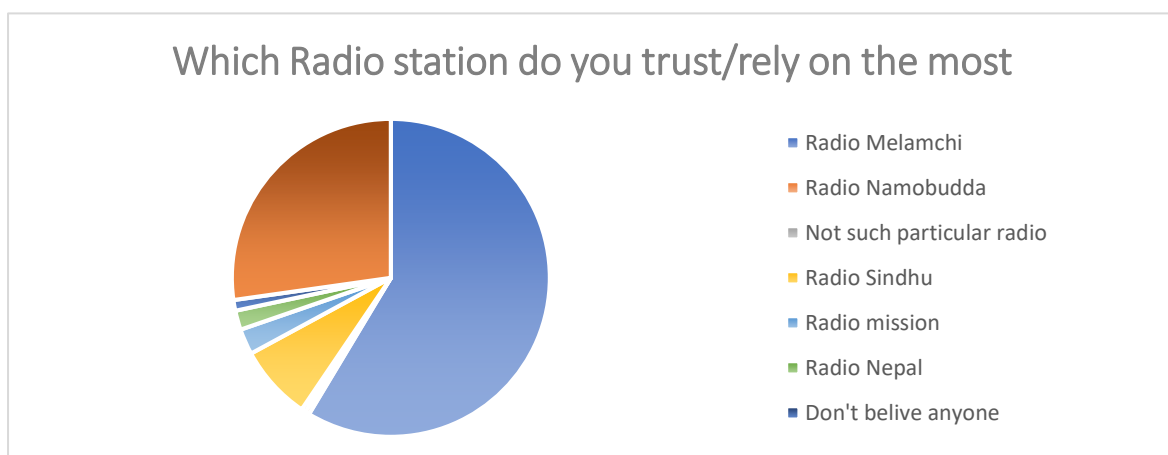
Figure 17 : Choice of radio station among the respondents

When looked into the variation across demographic factors, radios have significantly higher trust and reach between Janajati's (60.2%) and Dalits (65.6%). Among those reported as illiterate, radio (52.4%), family members (25.7%), and relatives (26.7%) have the most access. Similar trend is observed among older demographics, where radio also serves as the primary source of information (46-59 years: 65.3%, 60-70 years: 52.5% and 70 and above: 56.4%) as well as ones identified as differently abled (46.5%).

Among the respondents who participated in the survey, the top three most trusted TV channels are Nepal Television (15.7%), Kantipur TV (13.3%), and Ramailo TV (2.2%). Whereas a significant portion of the respondents (54.0%) reported not having a TV or never watching TV.

Internet usage and trust increase with higher education levels, which was reported by 77.5% of respondents with secondary or higher education level. Tailored messages leveraging online platforms and social media for younger audiences are more likely to reach a wider audience, especially those under the age of 30 and with secondary or higher education, who can in turn sensitize the community to the message.
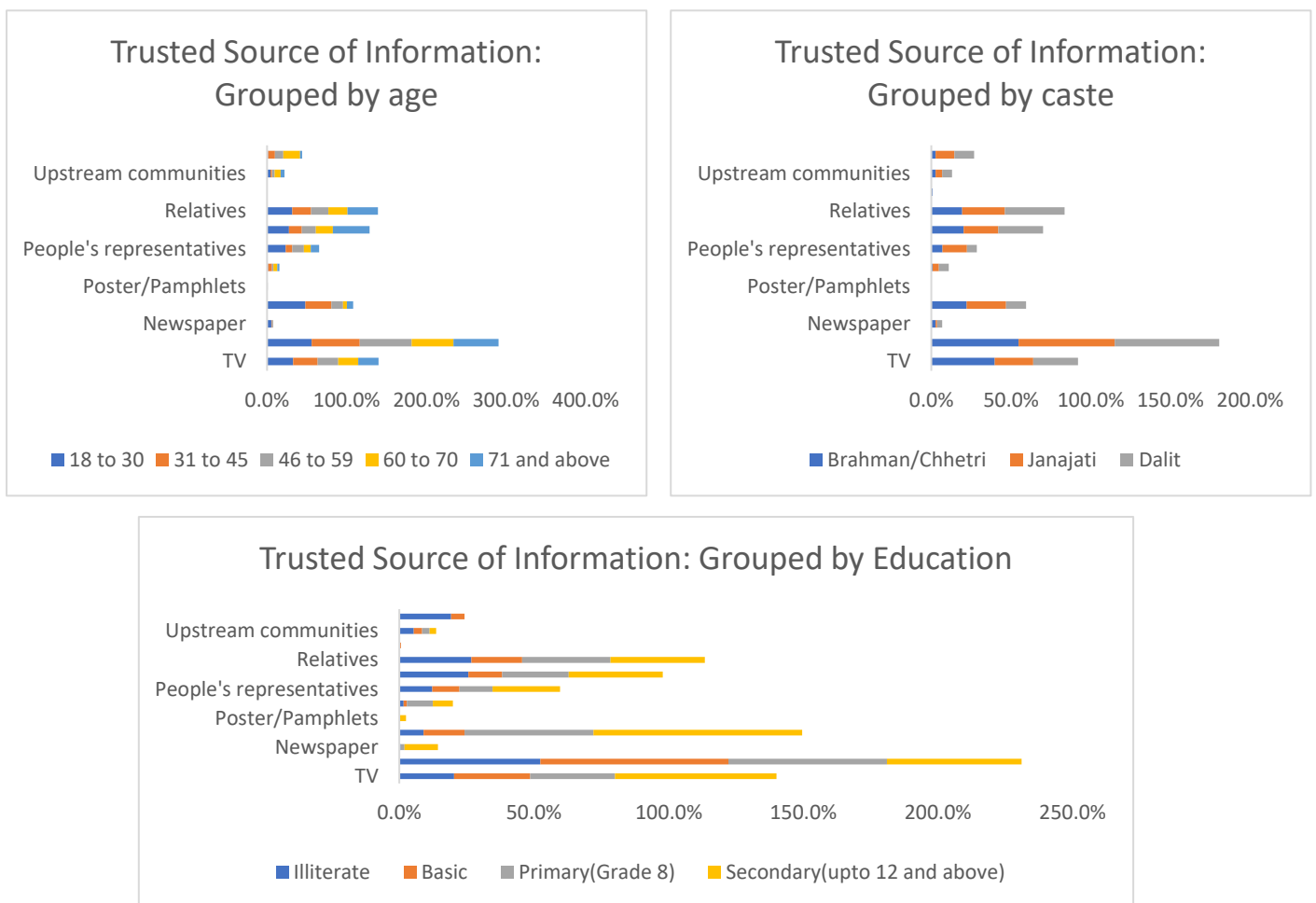
Figure 18 : Trusted source of information based on caste, age and education of the respondents

4.1.3.6 Media usage patterns for effective communication

More than half of the respondents (55%) reported that they do not have access to television to watch, while 27% of them stated that they lack a radio to listen to. Regarding the timing of media consumption, the survey shows that many respondents (42%) listen to the radio during the morning hours of 6 to 9 am. On the other hands, 26% of the respondents prefer watching television in the evening from 5 to 8 PM.
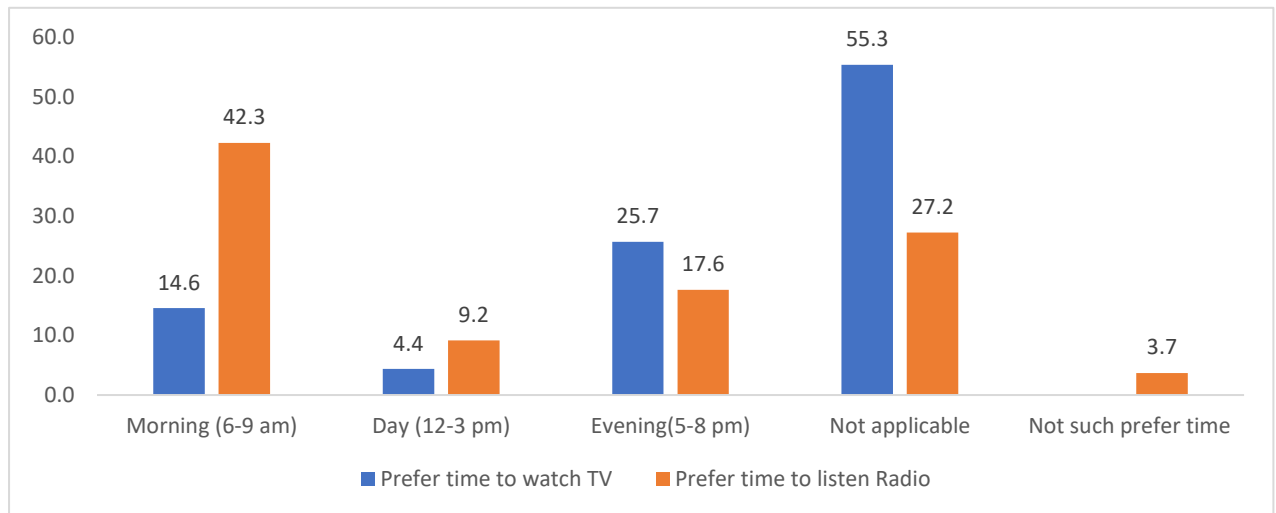
Figure 19 : Time preference for media usage

The study provides insights into efficient communication tactics by clarifying subtle trends in media use and preferences. Although especially underrepresented populations see radios as a reliable and approachable medium, it is impossible to ignore the growing influence of social media and the internet. Customized message and content delivery that is in line with usage trends and demographic preferences offer chances to enhance community involvement and resilience-building initiatives (IFRC, 2019).

4.1.3.7 Duration of using Mobile internet

Approximately 40% of the respondents need to utilize mobile internet. Of those who use mobile internet, 17.6% use it for 1 hour per day, while 14% use it for less than 10 minutes daily. Moreover, about 9% of the respondents reported using mobile internet for more than 3 hours daily.
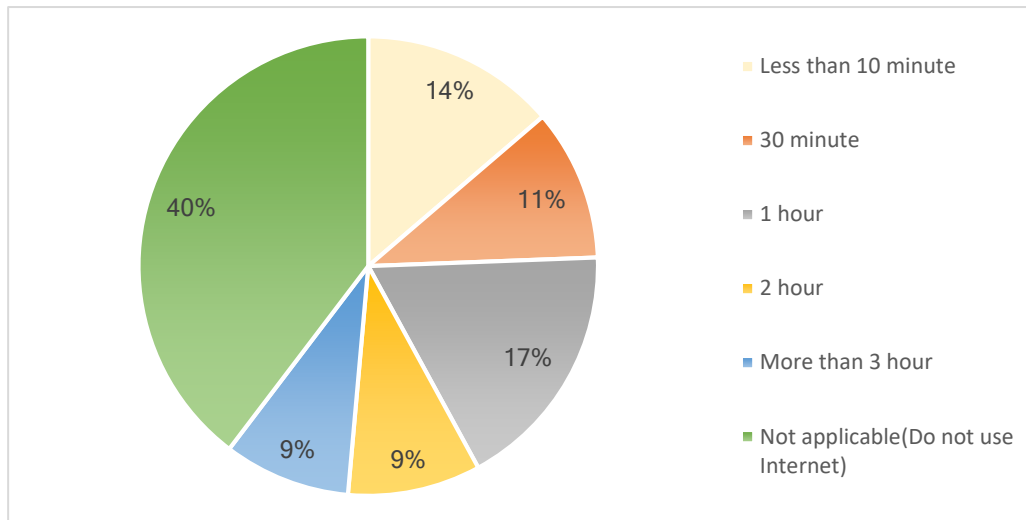
Figure 20 : Duration of using mobile internet

4.1.3.8 Social media

Approximately two-thirds of the respondents (65.4%) do not use social media. Among those who do use social media, Facebook is the most commonly used platform, with 28% of the respondents using it. Only 4% of the respondents reported using TikTok, while a very small number reported using other social media platforms.

4.1.3.9 Timing of use of social media

Out of the 159 respondents who use social media, the majority (47%) reported using it during the evening hours of 5 to 8 PM, while 22% use it in the morning hours of 6 to 9 AM. Afternoon is considered the least preferred time for using social media among the respondents. The preference for evening usage suggests that delivering content during this time might yield higher visibility and engagement.

4.1.3.10 Usage of Mobile Phone Network

The majority of respondents indicated using either Ncell (42.0%) or NTC Network (34.4%) as their mobile phone network. A notable percentage of respondents (22.9%) indicated that they do not use mobile phones.

4.1.3.11 Disaster Preparedness

The data indicates that there is a lack of preparedness among most of the respondents regarding floods or landslides. Only 22.2% indicated that they are prepared for floods or landslides related hazards likely to occur in their areas. While the majority of the respondents, 70.8%, reported that, they are not prepared for such disasters. A small percentage of respondents, 7.0%, expressed that they do not know if they are prepared or not.

Preparedness levels for floods or landslides vary across different demographic groups. The Dalit group has a remarkably higher level of reported preparedness (46.9%), while the Brahman/Chhetri group has the lowest (16.8%).

The lower preparedness level among respondents with disabilities emphasizes the need for inclusive approaches to disaster preparedness that address specific challenges and considerations faced by individuals with disabilities.

The higher percentage of "Don't Know" responses among older age groups and illiterate respondents suggests a need for tailored and accessible information and education on disaster preparedness targeting these groups.

The results highlight people of Melamchi Municipality's serious lack of preparedness, especially with relation to floods and landslides. These findings align with related research carried out in areas vulnerable to natural disasters (Smith et al., 2018; Patel et al., 2020). The findings of other research revealing socio-economic gaps in disaster readiness are consistent with the preparedness gap observed among demographic categories, with the Dalit community demonstrating stronger preparedness compared to Brahman/Chhetri communities (Wang et al., 2019).

Furthermore, the necessity for inclusive disaster preparedness methods that are tailored to meet varied needs is underscored by the disproportionately low level of readiness among respondents who have impairments (Twigg et al., 2017). Likewise, the significant proportion of "Don't Know" replies from illiterate and older respondents highlights the need for focused and easily accessible disaster readiness education efforts (Slovic et al., 2021).

4.1.3.12 Modes of Disaster Preparedness

The most common preparation reported by respondents in 97 valid responses across all categories, is the storage of necessary goods, with percentages ranging from 80.0% to 100.0%. Other notable preparations include flood-resistant building (ranging from 20.0% to 53.8%), primary health care, and first aid equipment.

Among the responses, early warning communication at local level and message dissemination are relatively under represented as preparedness measures, which highlights the need for strengthening such mechanisms and facilitating local involvement.

None of the respondents with disability as well as senior citizens above 70 years reported having any emergency funds as a preparation for disaster. Additionally, those who identified as disabled did not have any rationing of primary health care supplies.

The results of previous research are consistent with the predominance of keeping necessary items as the main readiness measure (UNDP, 2016). However, the lack of focus on early warning system communication and message distribution draws attention to a crucial weakness in disaster preparedness initiatives. As successful early warning systems greatly increase community resilience, it is essential to strengthen these mechanisms (Paton et al., 2017).

The lack of emergency funds and health care rationing among older adults and individuals with disabilities highlights the need for specialized support systems to meet these groups' unique vulnerabilities (UNISDR, 2017).

4.1.3.13 Training on disaster preparedness

The data suggests a lack of training in disaster preparedness among the surveyed population. The majority of respondents across all categories have not taken any training related to disaster preparedness; 88.7% of the respondents have not taken training and 9.4% are not aware of them.

Only nine of the respondents mentioned having participated in some forms of training, viz. First aid, firefighting, search, and rescue. Further consultation among community members revealed that the trained community members are most usually not in contact or have emigrated. The community members called for a mechanism that allowed for more frequent revisions on these trainings and transfer of knowledge.

Only 3.5% of the overall respondents mentioned having participated in any form of simulation or drills. The remaining 96.5% had not participated in such exercises. Outside of the respondents with secondary or higher education level, the community members seem to consistently lack such training, which include more vulnerable groups like children, senior citizens and individuals with disabilities.

The results of related studies support the serious issue that there is a general lack of training in disaster preparedness (Paton et al., 2019). According to Comfort et al. (2018), there is a need

for more extensive and easily accessible training programs, especially for vulnerable populations, as evidenced by the low participation in simulation exercises.

4.1.3.14 Disaster response plan

Only a small percentage (7.4%) indicated that their community/ward has a preparedness and response plan in place. Whereas the majority of respondents (92.6%) either don't know or reported that their community/ward does not have a disaster preparedness and response plan.

Among the respondents who indicated the presence of a disaster preparedness and response plan, the percentage of those who know about the implemented EWS varies across demographic categories; dalits and janajatis were found to have consistently low awareness about implementation of EWS.

The low proportion of communities with plans for preparedness and response indicates a global problem in disaster management (UNDRR, 2019). The importance of community engagement and awareness-raising measures in disaster planning processes is highlighted by specific demographic groups' lack of knowledge regarding the adoption of early warning systems (Coppola, 2015).

4.2 Qualitative Study
4.2.1 FGDs and KIIs:

FGDs and KIIs with key stakeholders, both at the local governance and community, along with vulnerable members of communities were conducted to glean additional insight and triangulate the findings of the household survey. The key personnel and group whom we had interview had been listed in annex section.

4.2.1.1 KIIs with Mayor, Chief Administrative Officer and Ward chairman

It became clear from the conversations with the Chief Administration Officer (CAO), Mr. Amrit Dhital, the Mayor of Melamchi Municipality, and other local officials that there are issues with the current disaster communication system. In an emergency, confusion is frequently caused by the current siren system's lack of a defined threshold. The need for better communication of likelihood, severity, and required actions was emphasized. It was emphasized to have actionable information from reliable sources in addition to carefully thought-out response strategies and improved training. It was noted how limited the availability of reliable climate services and meteorological data is, particularly on a local scale. It was underlined how crucial it is to educate and sensitize the local population about weather

information for a variety of industries, including transportation, agriculture, and local government.

The lack of clear protocols, limited resources, and poor use of prediction information for efficient disaster response were other important factors that were noted. The community and ward office levels' poor risk assessment and inadequate prioritizing make it difficult to obtain the resources and equipment that are required. The issues are exacerbated by the military's ambiguous protocol of action, which calls for the development of precise protocols and enhanced coordination between various reaction agencies and command levels. Beyond temporary fixes like building gabion walls, the necessity of integrated development and risk reduction initiatives was also underlined. It was also emphasized how crucial it is for local authorities to have professional advice and assistance when putting new and creative disaster risk management and resilience-building techniques into practice.

4.2.1.2 KII- Agriculture Sector

The agricultural sector has suffered greatly from many disasters in the Melamchi area, where it provides the majority of the community's income through agriculture; this has accounted for about half of the quantitative study's response. Primary crops farmed for sustenance include the Khumal Chaar breed of rice, corn, wheat, potatoes, and vegetables; barley and mustard are only sporadically cultivated for their oil content. A worrying pattern over the last five years indicates a decrease in total yield, which is linked to the usage of out-of-date seeds and erratic weather patterns. The industry has obstacles such as lack of market access and collecting hubs, particularly for small-scale farmers, as well as trouble getting labor and fertilizers in a timely manner. Wild animal encroachment, especially that of wild boar and monkeys, increases the risks to agriculture.

Important thoughts and recommendations have been put up to address these issues. These include imparting training on climate-resilient farming methods, supplying reliable sources for early warning information, and improving farming knowledge by incorporating meteorological information into agricultural activities. In order to increase community involvement, more resources and training are advised to help farmers mitigate the effects of climate change on agricultural productivity. These resources and training can include soil testing, adopting crop types resistant to climate change, and using resilient farming practices. Crucially, the recommended training should be scheduled for times when farmers are not as busy; this means

avoiding the busy months of Chaitra and early Baisakh and concentrating on the time after Baisakh.

4.2.1.3 KII- Media Sector

Following the 2021 flood, the local populace's awareness of risk seems muted, as evidenced by the authorities' reactive rather than proactive approach. Positive developments are manifesting, nevertheless, as a result of increased community involvement and continual training for media staff. The story is starting to cover preparedness, early warning, and mitigation of disasters instead of just disaster reaction. Among the main suggestions are interactive programs that combine community interviews with disaster risk reduction specialists and experts from the Department of Hydrology and Meteorology (DHM). This strategy promotes comprehension within the community and the transmission of engaging knowledge. It is advised to use radios to distribute DHM's three-day weather advisory in a way that is attractive to the local population, with careful scheduling to optimize audience engagement. By informing the public on local disaster management initiatives and providing updates on Local Emergency Operation Center activities, radio can also be an effective medium for accountability. To maintain these beneficial changes, media representatives and local authorities must receive additional orientation and training from DRR and communication specialists.

4.2.1.4 KII with Infrastructure Section Head

The National Disaster Risk Reduction and Management Authority (NDRRMA), the Department of Hydrology and Meteorology (DHM), and groups like RIMES, Practical Action, and REED Nepal have been working together to create a noticeable transition in the Melamchi municipality from post-disaster preparedness to proactive disaster mitigation and early warning. Informing local authorities about the vital significance of catastrophe mitigation through proactive measures has been greatly aided by these entities. Expanding these efforts' social reach and strengthening the distribution of knowledge is advised through working with formal, well-established groups associated with cooperative finance and agriculture. It is essential to allocate substantial resources to local authorities, DRR focal points, and sectoral stakeholders in order to raise awareness of disaster preparedness and response strategies. Comprehensive disaster risk reduction also requires sharing indigenous knowledge, encouraging community involvement, using schools for awareness campaigns, and advancing community-based early warning systems through technology.

4.2.1.5 KII: Municipal Disability Forum, Melamchi Municipality

The Municipal Disability Forum provided insight into the difficulties that the disabled community in Melamchi municipality faces while trying to integrate into local disaster management committees, particularly in Ward 11. Interviews brought to light the shortcomings of the warning systems in place, such as mobile phones and FM radio, in terms of reaching people with a variety of disabilities. Establishing an inclusive communication framework that accommodates all disabilities is essential to correcting this. The creation of precise policies and standard operating procedures that are adapted to the needs of people with disabilities in disaster risk reduction, the empowerment of leadership positions within the disability network, and the implementation of training initiatives for disability-inclusive disaster risk reduction are among the recommendations.

In addition, the plan calls for setting up a specific disability desk and designating a municipality focal point to oversee coordination, attend to individual needs, and guarantee that individuals with disabilities are fully included in crisis management preparations.

The qualitative analyses highlight systemic problems in risk assessment, resource allocation, and catastrophe communication, and they offer important context for the quantitative findings. The difficulties found align with more general talks about how disaster management needs better resource allocation, coordination, and communication (IFRC, 2020). Important stakeholders have made recommendations that stress the value of inclusive approaches, capacity building, and community involvement in boosting catastrophe resilience (Twigg et al., 2019).

4.3 Other findings

The disaster resilience and multi-hazard risk management of Melamchi Municipality have yielded several noteworthy findings (LDCRP Report, 2075; Disaster Risk Reduction and Management Act, 2076; Disaster Risk Reduction and Management Fund Operating Procedures, 2078) that shed light on the community's proactive approach to defending against potential threats. A thorough and organized approach to risk reduction is demonstrated by this regulatory framework and its operating standards (LDCRP Report, 2075; Disaster Risk Reduction and Management Fund Operating Procedures, 2078).

The municipality's commitment to strengthening disaster resilience is demonstrated by the development of local emergency operation centers, each of which is adequately funded (LDCRP Report, 2075). A decentralized and locally driven approach to disaster management is ensured by the governance structure, which includes the City Level Disaster Management

and Climate Uplifting Committee, Ward Level Disaster Management and Climate Uplifting Committee, and community-level counterparts (Disaster Risk Reduction and Management Act, 2076).

The provision of targeted training programs at the community level, covering essential skills such as search and rescue, first aid, and early warning dissemination, enhances the populace's preparedness and response capabilities (LDCRP Report, 2075; Disaster Risk Reduction and Management Act, 2076). This approach aligns with international best practices emphasizing the importance of community engagement in disaster risk reduction (UNDRR, 2015).

The proactive installation of flood early warning systems in high-risk areas, such as Talamarang, Bahunepati, and Melamchi Bazar, highlights the need for a customized and localized approach to risk reduction (Disaster Risk Reduction and Management Act; LDCRP Report, 2075). Concurrently, gathering supplies for search and rescue is a proactive measure that corresponds with the advice provided by specialists in disaster management (IFRC, 2019).

Melamchi Municipality's First Period Plan 2079/80-2083/84 recognizes disaster resilience and sustainable development as intrinsically linked, demonstrating a forward-thinking mindset by including disaster risk reduction and management as a key asset (LDCRP Report, 2075). Global frameworks like the Sendai Framework for Disaster Risk Reduction (UNDRR, 2015) are in line with this.

In addition, working together with the Department of Hydrology and Meteorology (DHM) to conduct a weather station audit and installing and updating weather stations and river level measurement sensors afterwards represents a cooperative effort with government organizations to leverage technology innovations for improved early warning capacities (LDCRP Report, 2075).

A strong regulatory framework (LDCRP Report, 2075; Disaster Risk Reduction and Management Fund Operating Procedures, 2078) and community-driven governance structures (Disaster Risk Reduction and Management Act, 2076) demonstrate the study's proactive approach to threat defense. A dedication to improving readiness and response skills has been seen in the implementation of flood early warning systems and targeted training programs (LDCRP Report, 2075). Melamchi Municipality's First Period Plan, 2079/80-2083/84) incorporates disaster risk reduction into sustainable development planning in a way that is

consistent with international frameworks (UNDRR, 2015). Meanwhile, cooperative efforts with government agencies, such as the Department of Hydrology and Meteorology, demonstrate a proactive approach to utilizing technology to enhance early warning capacities (LDCRP Report, 2075).

CHAPTER-V

CONCLUSION and RECOMMENDATIONS

5.1 Conclusion

The study of present methods of multi-hazard risk awareness and its constituents shed light on the complex perspectives and vulnerability present in Melamchi Municipality. The demographic research showed that different age groups, castes, and educational levels had varying levels of risk understanding. The heightened susceptibility of Dalits to several risks underscores the necessity of focused interventions and education campaigns in groups facing social and economic disadvantages. The fact that most wards have identified landslides as a common danger highlights the significance of conducting localized risk assessments. These results lay the groundwork for modifying educational programs and community outreach campaigns to reduce particular risk knowledge gaps across various demographic groups.

The assessment of the early warning systems and their effectiveness in reaching last-mile beneficiaries has revealed both strengths and shortcomings. Although most people receive weather forecasts, there are gaps in storm alerts and flood early warnings, especially for specific demographic groups. The confidence that people have in radio as a trustworthy information source underscores the medium's potential for communication. Nonetheless, the study notes that more inclusive communication frameworks are required, particularly for people with disabilities. In order to strengthen end-to-end early warning systems, the qualitative insights from important stakeholders—including media representatives—emphasize the significance of precise protocols, enhanced training, and dependable climate services. These results open the door to focused enhancements in communication tactics, guaranteeing that timely and correct information reaches every community section.

An analysis of Melamchi Municipality's institutional capacities reveals a more complex picture of the potential and problems associated with catastrophe management. The uncovered lack of preparedness highlights the necessity to strengthen capacities, indicating the urgency with which institutional readiness must be strengthened. Proactive mitigation techniques are required in light of key stakeholders' insights that highlight issues with the current disaster communication system. Inclusionary policies and targeted training are highlighted by recommendations from a variety of industries, such as disability forums and agriculture. These findings, in turn, provide a strategic pathway to enhance the institutional capacities of

Melamchi Municipality for strong disaster resilience and efficient risk management. They also open the door for focused policy reforms, resource allocation, and community-based initiatives.

5.2 Recommendations:

Key recommendations are:

1. Improve Communication Protocols: Collaborate with experts and community representatives to establish transparent communication protocols in the early warning systems, including clear risk thresholds and efficient dissemination mechanisms.

2. Implement Comprehensive Early Warning System: Develop and implement a modern, community-involved early warning system, leveraging diverse technologies and channels to ensure broad accessibility and effectiveness in various scenarios.

3. Empower Community-Based Committees: Establish disaster management committees with a focus on community engagement and localized response planning. Provide resources and training to enhance their capacity for effective risk response.

4. Invest in Continuous Training: Allocate resources for ongoing training programs to enhance the disaster response capabilities of community members, local authorities, and stakeholders. Conduct regular drills and simulations to identify and address response framework gaps.

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APPENDICES

1. Sampled Data for Household Questionnaire:

Ward No.	Total Population	Total Households	Sample Seize (HH)	Likely Hazard
2	1203	340	30	Landslide
4	2839	769	70	Landslide
6	2627	738	50	Multihazard (landslide, flood, fire etc)
11	5898	1536	100	Multihazard (landslide, flood, fire etc)
Total Sample Taken			250	

Table 3: Population of selected ward and Sample size

Note: This study had been utilizing simple random sampling based on cluster area sampling procedures. The results can be generalized to the population of each divisional secretariat at a confidence level of 95% and the desired level of accuracy of ± 5%. *(Cochran, 1963)*

$$n0 \ = \ \frac{Z_{95\%}^2 * p * (1 - p)}{e^2}$$

Estimated Prevalence (assume), p	0.50
q = 1 – p	0.50
Confidence Level, 1-α	95%
Z-value, $Z_{95\%}$	1.96
The margin of Error, e	0.05
$n0$	Sample size

Table 4: Parameters for sample size calculation

2. Key stakeholders' interview

Key Personnel/Group	Particulars
Local Government	Aitaman Tamang, Mayor of Melamchi Municipality Uma Pradhan, Deputy Mayor of Melamchi Municipality Amrit Kumar Dhital, CAO
Ward chairman	Nagendra Prasad Khatiwada, Sanjeev Tamang, Prem Bahadur Tamang, Chandra Bahadur Tamang
Agricultural Group	Sunita Khanal-Dhungana (Chairperson of Dhungana Besi Mahila Krishi Sangha | Dhungana Besi Women Agricultural Group) Krishna Dhungana, an agricultural worker, and teacher Kali Prasad Dhungana, the head of an agriculturally dependent family aged 72.
KII: Municipal official	Mr. Jit Bahadur Karki, Infrastructure Division Head of Melamchi Municipality
KII: Media	Devraj Subedi, radio host and producer at Radio Melamchi
KII: Municipal Disability Forum	Mr. Som Kumar Dulal, teacher at Jana Jagriti Secondary School and coordinator of the Municipal Disability Forum

Table 5 : Key stakeholders' interview

3. Disaster identification and classification of Melamchi municipality

प्रकोप स्तरीकरण	वार्ड हरु												
	१	२	३	४	५	६	७	८	९	१०	११	१२	१३
१	भुकम्प	भुकम्प	भुकम्प	भुकम्प	भुकम्प	भुकम्प	भुकम्प	भुकम्प	भुकम्प	भुकम्प	भुकम्प	भुकम्प	भुकम्प
२	पहिरो	पहिरो	पहिरो	वन्यजन्तु आक्रमण	वन्यजन्तु आक्रमण	पहिरो	पहिरो	पहिरो	पहिरो	पहिरो	वन्यजन्तु आक्रमण	पहिरो	बाढी
३	रोगकिरा	रोगकिरा	रोगकिरा	पहिरो	पहिरो	हुरीबतास	रोगकिरा	रोगकिरा	सुख्खा खडेरी	आगलागी	सुख्खा खडेरी	बाढी	हुरीबतास
४	महामारी	वन्यजन्तु आक्रमण	वन्यजन्तु आक्रमण	दुर्घटना	आगलागी	आगलागी	महामारी	महामारी	आगलागी	महामारी	हुरीबतास	आगलागी	वन्यजन्तु आक्रमण
५	असिना	असिना	असिना	आगलागी	असिना	वन्यजन्तु आक्रमण	असिना	असिना	चट्याङ्ग	सुख्खा खडेरी	आगलागी	वन्यजन्तु आक्रमण	चट्याङ्ग
६	चट्याङ्ग	बाढी	बाढी	चट्याङ्ग	बाढी	बाढी	चट्याङ्ग	चट्याङ्ग	वन्यजन्तु आक्रमण	हुरीबतास	चट्याङ्ग	हुरीबतास	आगलागी
७	बाढी	चट्याङ्ग	चट्याङ्ग	बाढी	चट्याङ्ग		बाढी	बाढी	बाढी	चट्याङ्ग	पहिरो	चट्याङ्ग	दुर्घटना
८	आगलागी	आगलागी	आगलागी	असिना			आगलागी	आगलागी	दुर्घटना	असिना	असिना	असिना	
९				हुरीबतास									

Table 6 : Disaster identification and classification of Melamchi municipality

4. Risk Maps of Melamchi
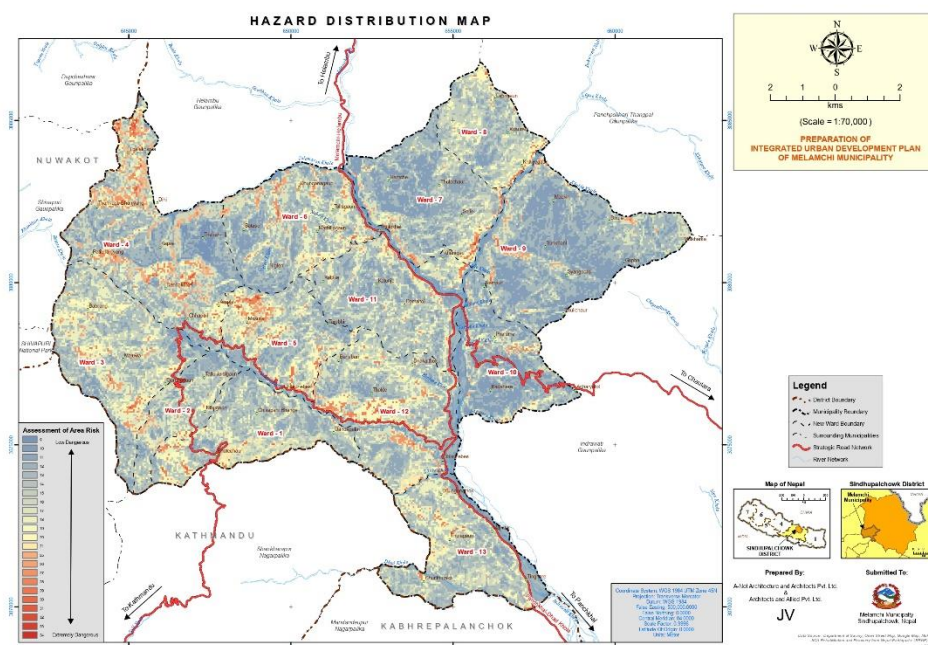
Figure 21 : Hazard Map of Melamchi

5. Landslide Hazard Map of Melamchi
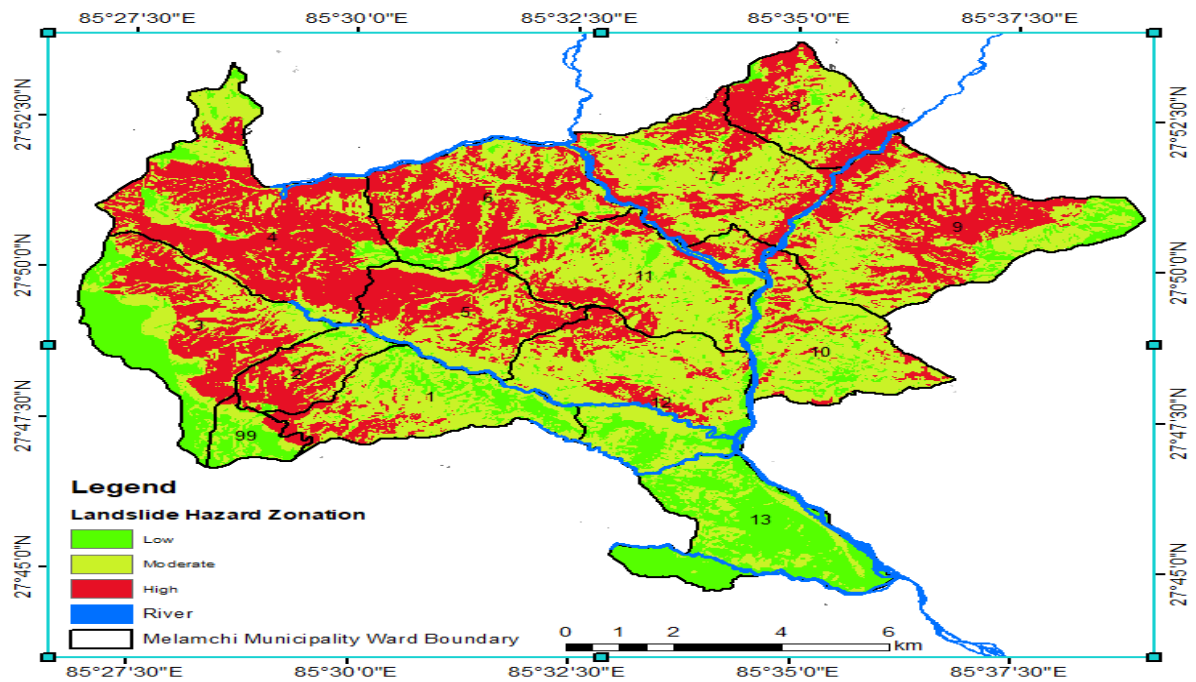
Figure 22: Landslide Hazard Map of Melamchi

6. Household Questionnaire Survey

A. Introduction
  - Introduction and Purpose of the interview:

My name is Sujan Dulal. I am a student pursuing M.Sc. in Environmental Science and management form SchEMS and doing my research work for the completion of the Master degree, I am now doing research to understand the current scenario of Melamchi municipality in terms of climate resilience and disaster risk reduction and management. Your experiences and advice will help us to tailor the activities and work more efficiently in the future. This interview will take around an hour to complete.

Time required- 60 minutes
  - Consent for the interview

B. Background

Background	
A) Name of Interviewer	Open
B) Survey District	Sindhupalchowk
C) Municipality	Melamchi
Ward no.	

C. Questions

1. Respondent profile (Skip patterns to be maintained after feedback on the tools due to numbering changes)				
1.1 Name				
1.2 Age (years)				
1.3 Gender:	[ ] Male [ ] Female [ ] Other			
1.4 No. of Household Members	Age less than 50 years		Age more than 50 years	
	Male	Female	Male	Female
1.5 Education	[ ] Illiterate [ ] Basic [ ] Primary (Grade 8) [ ] Secondary (grade 12) [ ] University degree			
1.6 Ethnicity	[ ] Brahmin/Chhetri/Thakuri [ ] Janajatis [ ] Dalits [ ] Other			
1.7 Occupation	[1] Farmer [2] Business [3] Service in the private sector [4] Service in the government sector [5] Daily wager [6] Unemployed [97]Other [7] Not applicable			
1.8 Do you have any kind of disability?	[1] Yes [2] No			

	If no please move to question 1.10
1.9 If yes, What kind of Disability?	[1] Physical disability [2] Visually impaired [3] Hearing and speech disability [4] Intellectual / mental disability
1.10 Are you or your any of the household member is in these groups?	[ ] Mothers group [ ] Youth Club [ ] Saving Credit Cooperative [ ] Farmers Group [ ] Listeners club [ ] Ward Disaster Management Committee [ ] Scout [ ] Task force
2. Risk Knowledge (Skip patterns to be maintained after feedback on the tools due to numbering changes)	
2.1 What are the major hazards in your locality? (Please take up to 3 options based on most recurrent hazard) Multiple options (MA)	[ ] Flood [ ] Drought [ ] Landslides [ ] Lightning [ ] Fire [ ] Hailstorm [ ] Windstorm [ ] other _____ (Please specify)
2.2 Do you know the major causes of flooding/landslides?	[ ] Yes [ ] No [ ] Don't Know If no then move to question 2.4
2.3 If yes, what are the factors leading to floods/landslides (Please select multiple answers)?	[ ] Monsoon [ ] Spring snow-melt [ ] Debris flow [ ] Others (please specify): _____
2.4 What is the major loss that your community have been facing due to recurrent hazard? Single Options (SO)	[ ] People's lives [ ] Infrastructures [ ] Agriculture [ ] All of above
2.5 What is the highest flood level in this area? (SO)	[ ]<1 meters [ ]<1.5 meters [ ]>2 meters [ ]>3 meters [ ]>3.5 meters [ ]>4 meters [ ] I don't know
2.6 What is the return period of the floods in this community? SA	[ ]less than 25 years [ ] 25 years [ ]50 years [ ]100 years [ ]200 years

2.6. Frequency of Hazard in your locality (SA)	Flood/Flash flood	Landslides
	o No occurrence	o No occurrence
	o Every year	o Every 2-3 years
	o Every 2-3 years	o Every 5 years
	o Every 5 years o Others_____ (Please specify)	o Others_____ (Please specify)

2.7 Have there been Flood/Landslide/Multi Hazard Maps prepared at ward/municipal level?	[ ] Yes [ ] No Skip to 2.11 [ ] Don't Know
2.8 If yes, how were these maps prepared?	[ ] Participatory tools [ ] GIS mapping
2.9 Have you or your community got access to these maps?	[ ] Yes [ ] No [ ] Don't Know
2.10 If yes, where are these maps kept/disseminated?	[ ] Municipal office [ ] Ward offices [ ] District Administrative Office [ ] Market place [ ] Schools
2.10a. If you have seen these maps, are you able to understand the maps and visualize the risk and vulnerabilities indicated in the maps.	[ ] Yes [ ] No [ ] Don't Know
2.11 In your opinion, which section of the population is most vulnerable to Disaster? (Multiple choice)	[ ] Senior citizens [ ] Women and Children [ ] Persons with disability [ ] Pregnant women [ ] Lactating Mothers [ ] Single women headed household [ ] Low income household [ ] Other (please specify)
2.12 In your opinion, which section of the population requires immediate lifesaving needs after disasters? (Multiple choice)	[ ] Senior citizens [ ] Women and Children [ ] Persons with disability [ ] Pregnant women [ ] Lactating Mothers [ ] Single women headed household [ ] Low income household [ ] Other_____ (please specify)
2.13 Are there any preidentified location for evacuation in your community in case of floods/landslides?	[ ] Yes [ ] No [ ] Don't Know
2.14 If yes, where are these locations?	[ ] School [ ] Open grounds [ ] Evacuation Shelters [ ] Ward offices [ ] Community buildings [ ] Other _____(please specify)
3. Pre-Shock Information/ Climate Services/Early Warning System	

3.1 Do you have Early Warning System in your areas?	[ ] Yes [ ] No [ ] Don't Know Skip to 3.4
3.2 If yes, what kind of forecast/early warning/advisories have you received?	[ ] Weather Forecasts [ ] Flood Forecasts [ ] Storm Early Warning [ ] Flood Early Warning [ ]Agro met related Advisories
3.3 If yes how many days in advance have you received the early warning and forecast?	[ ] 1-3 days [ ] 3-6days [ ] More than 7 days [ ] Other specify
3.4 Do you also receive information of floods from upstream communities?	[ ] Yes [ ] No [ ] Don't Know If No and Don't Know, go to 3.7
3.5 If yes, what was the source of information?	[ ] TV [ ] Radio [ ] Newspaper [ ] Internet [ ] NGOs [ ] Social Media [ ] Poster/Pamphlets [ ] Government officials [ ] Elected representatives [ ] Family members [ ] Relatives [ ] Vulnerable group organizations [ ] Upstream communities [ ] Others_____(Please specify)
3.6 Which information source you trust/rely the most?	[ ] TV [ ] Radio [ ] Newspaper [ ] Internet [ ] NGOs [ ] Social Media [ ] Poster/Pamphlets [ ] Government officials [ ] Elected representatives [ ] Family members [ ] Relatives [ ] Vulnerable group organizations [ ] upstream communities [ ] Others_____(Please specify)
3.7 If you did not receive the information, what were the reasons in your opinion?	[ ] Lack of communication devices [ ]Isolation from other households prevented dissemination of information [ ] Discrimination against us [ ] Other
3.8 Among mainstream TV channels, which do you trust/rely on the most?	
3.9 Among mainstream radio stations, which do you trust/rely the most?	

3.10 What time do you prefer watching TV?	[] Morning (6-9 am) []Day (12-3pm) []Evening (5-8pm)
3.11 What time do you prefer listening to radio?	[] Morning (6-9 am) []Day (12-3pm) []Evening (5-8pm)
3.12 How long do you use mobile phone for internet in a day?	[] Less than 10 mins []30mins []1hr []2hr []More than 3hrs
3.13 Which social media do you use the most?	[] Facebook []Twitter []TikTok []Instagram
3.14 What time of the day do you prefer to use social media?	[] Morning (6-9 am) []Day (12-3pm) []Evening (5-8pm)
3.15 Which mobile phone network do you use?	[]Ncell []Ntc []SmartCell
3.16 Which internet service provider do you use?	[]World Link []Vianet []ClassicTech [ ] Other specify
3.17 What purpose do you use internet for?	[]Social Media []Radio []News []Music []Others
4. Preparedness/Response Capacities (community)	
4.1 Are you prepared for floods or landslide likely to occur in your areas?	[ ] Yes [ ] No [ ] Don't Know
4.2 If prepared, what are the preparations? (Multiple choice)	[ ] Storage of necessary goods [ ] Flood resistant building [ ] Risk and exposure maps [ ] Trainings on first aid, search and rescue [ ] Primary health care and first aid equipment [ ] Stock piling of emergency LSAR and WASH materials [ ] Emergency funds [ ] Early warning and communication at local level [ ] early action protocols prepared [ ] Other_____ (Please specify)
4.4 Have you taken any training related to disaster preparedness?	[ ] Yes [ ] No [ ] Don't Know

4.5 If yes, what are the trainings you have participated related to disaster preparedness? (Multiple Response)	[ ] First aid [ ] Firefighting [ ] Water, Sanitation and Hygiene [ ] Search and rescue [ ]Vulnerability and capacity assessment [ ] Community based Disaster Management [ ] Early warning system [ ] Others_____(Please Specify)
4.6 Does your community/ward have disaster preparedness and response plan?	[ ] Yes [ ] No [ ] Don't Know
4.7 If yes do you know what EWS are implemented based on what are in these plans?	[ ] Yes [ ] No [ ] Don't Know
4.7 Have you participated in drills and simulation exercise?	[ ] Yes [ ] No [ ] Don't Know
4.8 If yes, did you find it effective?	[ ] Yes [ ] No [ ] Don't Know
4.9 Please propose 3 key activities that would help you and your community to prepare for disaster (floods and landslides).	

7. Focused Group Discussions Checklist

Tool 2 Focused Group Discussions (At risk Communities and Vulnerable Population)

- Introduction:
- Sharing of objectives
- This questionnaire will be conducted with the local vulnerable communities, at risk population)

Community ID	
Facilitator's Name	
Date (DD/MM/YY)	

Demographic Information of the Community

Community Name	
Address	
GPS	
How many households are there in the community?	
What is the estimate population of the community?	
What is the demographic percentage of the community based on the ethnic category?	(Estimate in percentage) Brahman/Chhetri Hill Janajati Hill Dalit Other
What are the different primary languages used in the community?	(Estimate in percentage) Nepali Local Language...
What is the average literacy rate of the community?	
Is there any socio-cultural aspect of the community that can be considered as a hindrance to any development?	[ ]Yes [ ] No
If yes, what are them?	1. _____ 2. _____ 3. _____
Are there are any displaced or migrant communities?	

Economy and Infrastructure Information

What are the key sources of income and livelihoods?	
What is the average income rate of the community?	

What are the sources of fuel of the community? (Starting with the largest uses in percentage)	1. _____ 2. _____ 3. _____ (Estimate in percentage)
Is electricity available in the community?	[ ]Yes [ ] No
How many households are connected to the electricity?	(Estimate in percentage)
How far is the road from the community? (Access for relief and evacuation)	[ ] 15-30 minutes [ ] 30-60 minutes [ ] More than an hour
How far is the public transportation from the community?	[ ] 15-30 minutes [ ] 30-60 minutes [ ] More than an hour
What are the health facilities in the community? (tick multiple if available)	[ ] Health post [ ] Clinic [ ] District hospital [ ] Other facility
Which community is farthest from HF/hospital?	
How long does it take/or what is the distance? In Minute	
What is the highest education level school available in the community? (tick multiple if available)	[ ] Primary School [ ] Secondary School [ ] College [ ] Other

Disaster Risk Management

What are the key disasters events in the area?	
Is there Early Warning System placed in the community?	[ ]Yes [ ] No
How does the community communicate information?	
How is EWS and Warning Information (WI) received?	
How useful is EW and WI?	
How will EWS and WI be useful to reduce disaster risks? Are there any local practices of using them?	
Who suffers the most and why during any type of shocks/disasters?	

What is local governments/communities' approach to address disaster risks?	
How SP mechanisms can be used to reduce the number of people affected or number of people to be responded during disasters?	
Are you aware on any local/ level policies on DRR and Social Security Allowance? What do you know? In your opinion, which groups know more, and which groups do not know details?	
Do you have experiential information on disaster recurrence period? What is it? How do you verify this?	
Do you have any further feedback in using FbA approach including its linkage with SRSP?	
Has the community heard of Disaster Risk Management?	[ ]Yes [ ] No (Estimate in Percentage)
Has the community been an implementing area for any Disaster Risk Management project?	[ ]Yes [ ] No
Can you list the project and the implementing organisations?	1. _____ 2. _____ 3. _____
If yes, what were the specific software activities related to DRM that were conducted?	1. _____ 2. _____ 3. _____
Were the most vulnerable groups included in the programs especially of Persons with Disabilities (PwDs)?	[ ]Yes [ ] No
If no, what were the reasons for their exclusion?	1. _____ 2. _____ 3. _____
Was any disaster prevention infrastructure built in the community?	[ ]Yes [ ] No If yes, what are them and when were they built? 1. _____

	2. _____ 3. _____

Were any infrastructure built for easy access for the vulnerable especially for PwDs?	[ ]Yes [ ] No
	If yes, what are them and when were they built?
	  1. _____
	  2. _____
	  3. _____

How does the community ensure that the most vulnerable and most at risk communities are in reach of the information?	1. _____ 2. _____ 3. _____
Does community also consider indigenous knowledge while monitoring hazards like floods, landslides, thunderstorm?	[ ]Yes [ ] No
If yes, could you please specify the key things considered while monitoring hazards like floods, landslides, thunderstorm?	

Disaster/Shock History

What were the major disaster/shock occurred in the community? (Start from the latest including the year of occurrence)			
Disaster/Shock	Year	Loss and Damage	Property loss

FLOOD/LANDSLIDE DISASTER
Can you define the disaster emergency response of the latest flood/landslide disaster in detail?
Can you tell us about how the community were able to assist the vulnerable groups or most at-risk communities during the evacuation to safe location?
Can you tell us about process of assistance that you received during the response? (from listing of name to receiving).
How were the vulnerable people assisted in this process especially of PwDs?
Were there any hindrance/difficulties during the process? If so, what were those hinderances

Was there any assistance/support from the organization that used the concept of SRSP to provide assistance? If yes, state in details?

8. Photographs

Figures: Automatic weather station and River level sensor in the upstream of melamchi

Figure: Sirens in the Melamchi regions

	Melamchi Municipality		
	Office of the Municipal Executive		
	Melamchi, Sindhupalchok		
	विपद् व्यवस्थापनका लागि आवश्यक सामग्रीहरु		

S.N.	Particulars	Specification	Units	Quantity
1	Bolt Cutter	12"	Pc	5
2	Hand Saw	18"	Pc	10
3	Harness	Full body	Pc	4
4	Carabineer Figure Eight	Carabineer Figure Eight	Pc	8
5	Almunium Ladder	4.4 M Telescopic ladder	Pc	2
6	Rubber Tube	large inner tube Big rubber tube -26	Pc	10
7	Resque throw bag	EMS-A411E hot sale resque compact throw	Pc	
8	Life line rope	10mm Nylon double Brided-anchor- line rope	Mtr	300
9	HV Pyanther Search Light	ASL500lm fluorescence hook magnet folding portable	Pc	10
10	Mega Phone	New handy bullhorn megaphone hand handheld loudhailer	Pc	4
11	Tow Chain	12 mm steel wire rod	Mtr	150
12	Pulley	Climbing Single Pulley,Load: about 20KN	Pc	
13	Hand Saw	Petrol machine	Pc	2
14	First Aid Tools	25 person first aid box	Pc	20
15	Climbing/Repaling Rope	10mm nylon double braded anchor line rope	Mtr	300
16	Sleepnig Mat	10 mm (4*6 ft)	Pc	60
17	Tarpolian	18*24 Ft	Pc	60
18	Tarpolian	12*18 Ft	Pc	60
19	Tourchlight	Metal Body with Battery	Pc	10
20	Chargeable Head light Tourch	USB rechargeable sensor	Pc	10
21	Strecher	Heavy and folding	Pc	20
22	Pick Axe	with Handle	Pc	20
23	Crow Bar	1.5 Inch	Pc	10
24	Shovel	with Metal Handle	Pc	20
25	Wheelbarrow	Heavy	Pc	10
26	Blanket	with double layer	Pc	80
27	Plastic	400gsm	Kg	200
28	Fire extinguisher	(5 kg)	Pc	5
29	Concrete Breaker Machine	Bosch GBH 8-45 DV Professional Rotary hammer	Pc	2
30	Stoning Hammer	1 Kilograms 10.24 x 3.94 x 1.97 inches	Pc	5
31	Visible Jacket	Simple	Pc	30
32	Firefighter Suit	Firefighter Suit	Pc	4
33	Rubber Boot	Common Sizes	Pc	30
34	Working gloves	Handa Black Industrial Natural Rubber Safety Glove	Box	30
35	Rappelling gloves	Ringers Gloves R-353 Rope Rescue Glove with Padded Palm for Rappelling	Pc	10
36	Life Jacket	Color: Bright Orange Size: XL Sizes	Pc	20
37	Life Bag	Life Bag	Pc	5
38	Life Ring	Life Ring	Pc	5
39	Seat Harnees	Common Sizes	Pc	5
40	Safety Helmeat	Safety Helmeat	pc	50
41	Fire Bitter	Fire Bitter	Pc	50
42	Nylon Double Branded Rope	10mm anchor line rope	Mtr	300

Figure: Search & rescue materials storage and list of Melamchi municipality

Figure: Questionnaire and discussion with the deputy mayor ward chairperson and other stakeholders