

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

**ASSESSMENT OF THE FLOOD INDUCED LOSS AND
DAMAGE BY USING MULTI-DIMENTIONAL POVERTY
INDEX IN MELAMCHI MUNICIPALTY SINDHUPALCHOWK,
NEPAL.**



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Pokhara University, Nepal

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**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

**Submitted by
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Exam Roll No: 22255016
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DEDICATION

I dedicate this research to my family: Mr. Raj Kapur Sorali, Mrs. Binita Rana, Ms. Renisha Sorali, and Mrs. Renuka Soraly. Their constant support and belief in me have been instrumental in my academic journey. Their encouragement has inspired me to persevere and achieve my goals.

Dharma Raj Sorali

DECLARATION

I, Dharma Raj Sorali, hereby declare that this thesis entitled “**ASSESSMENT OF THE FLOOD INDUCED LOSS AND DAMAGE BY USING MULTI-DIMENSIONAL POVERTY INDEX IN MELAMCHI MUNICIPALTY SINDHUPALCHOWK, NEPAL**” is entirely my original work. I acknowledge all contributions and sources appropriately. This thesis has not been submitted to any other institution for any degree. I take full responsibility for the content and findings presented in this work. This declaration is made to ensure transparency and integrity in my academic endeavors. Thank you for considering my submission.

.....

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RECOMMENDATION

This is to recommend that the thesis entitled “**ASSESSMENT OF THE FLOOD INDUCED LOSS AND DAMAGE BY USING MULTI-DIMENTIONAL POVERTY INDEX IN MELAMCHI MUNICIPALTY SINDHUPALCHOWK, NEPAL**” have been carried out by Mr. Dharma Raj Sorali 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 work and its findings has not been submitted for any other degree.

.....

Supervisor

Asst. Prof. Praveen Kumar Regmi

Date:

CERTIFICATION

This is to certify that the thesis entitled “**ASSESSMENT OF THE FLOOD INDUCED LOSS AND DAMAGE BY USING MULTI-DIMENTIONAL POVERTY INDEX IN MELAMCHI MUNICIPALTY SINDHUPALCHOWK, NEPAL**” submitted by Mr. Dharma Raj Sorali 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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ACKNOWLEDGEMENT

I would like to express my deep gratitude to my supervisor, Assistant Professor Praveen Kumar Regmi, for his unwavering inspiration, intellectual contributions, and insightful suggestions that have significantly shaped my research journey. His invaluable feedback has been instrumental in guiding me through the complexities of this work.

I would like to offer my sincere gratefulness to my principal and advisor Assoc. Prof. Ajay Bhakta Mathema for his feedback and guidance in completing this work. Furthermore, I would like to acknowledge the financial support provided by the NORHED II project. And, I would like to express my acknowledge to the administrative staffs of SchEMS for their assistance and support in facilitating this research. Their efforts were crucial in ensuring a smooth and efficient research work. Additionally, I am grateful to the Melamchi Municipality and ward chairpersons for their cooperation and provision of essential information.

A special thanks to Mr. Sujan Dulal, Environmental Officer of Melamchi Municipality for his exceptional dedication and assistance throughout the survey process. His expertise and local knowledge were invaluable in ensuring the successful completion of the field work. I would also like to acknowledge the warm hospitality and cooperation of the local people, whose support was instrumental in conducting this research.

I am also grateful to Mr. Rajiv Gubhaju, Ms. Jeni Dahal and Ms. Laxmi Chhinal, Program Co-Ordinator and my classmates for their unwavering support and encouragement throughout my academic journey. And I would like to thank my family for their constant love, support, and belief in me.

Last but not the least, I would like to express my deep gratitude to everyone who has helped me with this project. Their ongoing support, guidance, and encouragement have been my motivation for making significant progress in this research.

Dharma Raj Sorali

LETTER OF APPROVAL

This dissertation paper submitted by Mr. Dharma Raj Sorali entitled “**ASSESSMENT OF THE FLOOD INDUCED LOSS AND DAMAGE BY USING MULTI-DIMENTIONAL POVERTY INDEX IN MELAMCHI MUNICIPALTY SINDHUPALCHOWK, NEPAL**” has been accepted for the partial fulfillment of Master of Science in Environmental Management from Pokhara University.

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ABSTRACT

Flooding is one of the most frequent and devastating natural disasters, particularly impacting developing nations like Nepal. The June 2021 flood in Melamchi Municipality exemplified this, causing extensive damage to infrastructure, displacing hundreds of families, and highlighting the community's vulnerability to climate change. The Multidimensional Poverty Index (MPI) serves as a critical tool for assessing the socio-economic impacts of such disasters by considering various deprivations beyond income, including health and education. This study aimed to evaluate the flood-induced loss and damage in Melamchi Municipality using the MPI and socio demographic survey such as HHS, FGD and KII to understand how such events disproportionately affect impoverished households. The research findings revealed 0.03 MPI variation before and after flood which indicated that only 3% of people are considered to be multidimensionally poor, a significant increase in households classified as experiencing "High" poverty post-flood, particularly in wards 10 and 11. Specifically, Ward 10's MPI rose from 0.14 to 0.15, while Ward 11 experienced a dramatic increase from 0.12 to 0.27, indicating severe deterioration in living conditions. Overall, the number of households categorized as "High" poverty increased from 40 before the flood to 52 afterward, while those in "Low" poverty dropped from 58 to 38. Correlation analysis demonstrated a strong relationship between flood-induced loss and increased poverty levels across all observed wards. This stark reality emphasizes the urgent need for comprehensive disaster recovery strategies that address both immediate needs and long-term resilience. The MPI's multifaceted approach enables stakeholders to identify vulnerable populations requiring targeted assistance in recovery efforts. Additionally, integrating local knowledge into recovery strategies fosters community ownership and ensures that initiatives are culturally appropriate. By employing the MPI in assessing flood impacts, policymakers can prioritize resources effectively and develop targeted interventions that promote equity in disaster response efforts. Ultimately, addressing the intersection of multidimensional poverty and flood risk is essential for developing effective disaster management strategies that enhance resilience and sustainability in Melamchi Municipality. Understanding this relationship will be crucial for creating inclusive disaster risk reduction measures that not only aim for immediate recovery but also focus on long-term socio-economic stability for affected communities.

Keywords: *Climate Change, Flood, Loss and Damage, MPI, Poverty.*

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LIST OF ABBRIVIATIONS

| | |
|---------|--|
| ADB | Asian Development Bank |
| DHM | Department of Hydrology and Meteorology |
| DID | Difference in Difference |
| GoN | Government of Nepal |
| ICIMOD | International Centre for Integrated Mountain Development |
| IIED | International Institute for Environment and Development |
| IPCC | Intergovernmental Panel on Climate Change |
| LDCs | Least Developed Countries |
| LMICs | Low and Middle-Income Countries |
| SoVI | Social Vulnerability Index |
| MoFE | Ministry of Forests and Environment |
| MoHA | Ministry of Home Affairs |
| MPI | Multidimensional Poverty Index |
| NDRRMA | National Disaster Risk Reduction and Management Authority |
| NPC | National Planning Commission |
| NSO | National Statistics Office |
| OPHI | Oxford Poverty and Human Development Initiative |
| UN OCHA | United Nations Office for the Coordination of Humanitarian Affairs |
| UNDP | United Nations Development Programme |
| UNDRR | United Nations Office for Disaster Risk Reduction |
| UNFCCC | United Nations Framework Convention on Climate Change |
| WHO | World Health Organization |

CHAPTER 1

INTRODUCTION

1.1 Background

One of the most frequent natural disasters, flooding can have devastating effects, particularly in developing nations. Floods endanger people's livelihoods and have an impact on world development (Rentschler, Salhab, and Jafino, 2022). According to Arefi, Behr, and Alidoost (2018), "global warming, weather change, and urbanization" are the main causes of the global increase in floods. The rate of snowmelt runoff has risen due to global warming (IPCC, 2018). The Himalayas flood as a result of monsoon-season precipitation and early snowmelt (Hayat et al., 2019). The conversion of croplands, pastures, forests, and wilderness areas into impermeable urban surfaces like streets, buildings, businesses, and highways has decreased infiltration and increased surface runoff, leading to flooding (Whitford, Ennos, and Handley, 2001; Goonetilleke et al., 2005). The majority of those affected by flooding worldwide roughly 23% of people live in South and Southeast Asia (Rentschler, Salhab, and Jafino, 2022). Floods can be fatal and cause damage to buildings, infrastructure, and crops (Monirul Qader Mirza, 2002).

According to Warner and van der Geest (2013), the term "loss and damage" refers to the adverse effects of harsh and/or slow-onset weather phenomena that humans are either completely or insufficiently able to adapt to or cope with. The actual or potential manifestation of climate change's negative effects on human and natural systems is referred to as loss and damage. While "loss" refers to effects for which there is no chance of recovery or restoration, "damage" refers to aspects that can be recovered but at a cost (UNFCCC, 2012). The government of Nepal has also defined loss and damage as potential negative manifestations of climate change on slow-onset events like glacier retreat, drought, and heatwaves, as well as on sudden-onset extreme events like heatwaves and extreme rainfall, to which people in the country's mountains, hills, and Tarai region are unable to adapt or cope. When the nation's natural ecosystems, infrastructure, and institutions are overwhelmed, it results in the loss of life, livelihoods, and cultural heritage (MoFE,2021a). Loss and damage are divided into two categories by the UNFCCC: economic and non-economic. Economic losses are the most readily quantifiable impacts of floods. These refer to the measurable financial losses incurred by individuals,

businesses, and governments. Here are some key aspects (Merton et al., 2020). The economic loss includes all lost resources, products, and services that have a marketable worth and may be valued financially. Non-economic losses are often more challenging to quantify but are equally important to consider. These refer to the social, psychological, and cultural impacts of floods that are not easily captured in monetary terms (Iyer et al., 2022). A wide variety of losses that are not expressed in monetary terms and are not frequently exchanged on markets are referred to as non-economic losses and damages (UNFCCC, 2023).

Loss and damage resulting from climate change are closely associated with poverty. Due to their lack of resources and frequent location in geographically susceptible places, impoverished communities who historically have made the least contribution to greenhouse gas emissions have not been able to adjust to a changing climate. These communities suffer more than others when climate disasters like floods, droughts, or extreme weather events occur. This can create a vicious cycle in which people become impoverished as a result of loss and damage, and their poverty increases their susceptibility to the effects of climate change in the future (UN OCHA, 2023 & IIED, 2022).

Since poverty is a complicated problem, it's possible that standard measures of it, such as the Multidimensional Poverty Index (MPI), aren't capturing all the ways in which poverty is specifically made worse by climate change. The long-term effects on livelihoods and losses resulting from climate events may not be immediately taken into account by the MPI, which takes into account variables like health, education, and standard of living. Poverty indicators, however, are still a useful tool. We can gain a better understanding of the relationship between poverty and climate change by examining changes in poverty levels in areas that are frequently affected by climatic disasters in addition to climate data (WHO, 2023). This can assist in identifying communities that are at risk and directing resources toward resilience-building and adaptation.

Utilizing the MPI in assessing the aftermath of the Melamchi flood provides valuable insights into how different socio-economic groups were affected. The MPI's multi-faceted approach enables stakeholders to identify vulnerable populations who may require targeted assistance in recovery efforts. For instance, households lacking access to education or healthcare services may face greater challenges in rebuilding their lives post-disaster (UNDP, 2020). This approach

is particularly relevant in Nepal, where socio-economic disparities are pronounced and often exacerbated by natural disasters.

The June 15, 2021, flooding in Melamchi resulted in significant harm, upsetting the livelihood and economy (Maharjan et al., 2021). The notorious Melamchi flood caused 525 households to be displaced, 23 people to be reported missing, 17 casualties, and 13 suspension bridges to be destroyed. It also negatively impacted the Melamchi Water Supply National Project, resulting in an economic loss of more than 7.8 million USD (Pandey et al. 2021; NDRRMA 2021; Dahal et al. 2021; Sharma et al. 2022; Takamatsu et al. 2022; Pettey D 2021). Due to the strong erosiveness of the Melamchi watershed, the river's sediment dynamics are higher (Baniya et al., 2023). The regional flow contribution during flooding episodes is also significant, as demonstrated by the Melamchi flood (Tirtha et al, 2023). Previous studies at Bhemathang focused on factors contributing to heavy river debris, including rainfall intensity and landslide-induced damming. This research shifts focus to the Melamchi River, investigating the relationship between flood discharge, precipitation patterns, and temperature-driven snowmelt, within the broader context of climate change (Baniya et. al., 2024). Determining how temperature and precipitation contribute to Melamchi floods may be more important and useful in determining how climate change affects floods in the Himalaya and elsewhere.

Moreover, integrating local knowledge into assessments can enhance recovery strategies. Engaging communities in understanding their unique challenges fosters a sense of ownership and ensures that recovery initiatives are culturally appropriate. Local participation can also help identify specific needs that may not be captured through conventional assessments (ICIMOD, 2021). This participatory approach aligns with global frameworks advocating for inclusive recovery processes that address both immediate needs and long-term resilience. The findings from applying the MPI in Melamchi can guide policymakers in prioritizing resources effectively. For example, rebuilding infrastructure with climate resilience in mind can significantly reduce vulnerability to future disasters. Additionally, incorporating disaster risk reduction strategies into urban planning is essential for enhancing community resilience against extreme weather events (ADB, 2021).

1.2 Statement of the Problem

As per the Intergovernmental Panel on Climate Change (IPCC) in August 2021, every part of the world has experienced climatic changes. The effects of climate change are growing and becoming increasingly apparent. After drought, floods are the disaster that has the greatest effect on agriculture. Between 2008 and 2018, it cost Least Developed Countries (LDCs) and Low Middle-Income Countries (LMICs) USD 21 billion in losses. One of the nation's most susceptible to natural calamities worldwide is Nepal (GON, 2019). Nepal experiences flood every year during the monsoon season due to excessive precipitation. While riverine flooding and inundation of low-lying areas put the lives and economies of the people of the Terai region at risk, flash floods and landslides are major climate-related risks in the mountains and hills (MoHA, 2018, UNDRR, 2019).

The Sindhupalchowk District's Melamchi Municipality regularly receives torrential monsoon rains, which can cause disastrous floods. The local population's livelihoods depend heavily on the homes, farms, and infrastructure that are severely damaged by these floods. The flooding issue is made worse by the Municipality's topography, inadequate drainage, and deforestation (Shrestha et al., 2018). One important aspect that affects how severe the effects of the floods are in Melamchi is poverty. Poor households can't afford to live in safer places; thus, they frequently live in high-risk neighborhoods. They are especially vulnerable since they do not have the resources required for proper flood recovery and preparation (Ghimire & Upreti, 2020).

The poorest households in Melamchi Municipality experience a disproportionate amount of loss and destruction due to flooding, primarily due to their socioeconomic vulnerabilities that hinder effective prevention and recovery from such disasters. These vulnerabilities are particularly severe for individuals living below the multidimensional poverty line, as the absence of targeted assistance and compensatory measures exacerbates their plight (World Bank, 2022). For instance, following the catastrophic floods in June 2021, many affected families reported receiving minimal support from local authorities, leaving them struggling to rebuild their lives (Dialogue Earth, 2021). The lack of focused disaster risk reduction strategies further compounds this issue, as marginalized communities often lack access to the resources and information necessary to mitigate flood risks effectively (Shrestha, 2023).

Understanding the connection between multidimensional poverty and flood damage is crucial for creating inclusive and equitable disaster risk reduction measures. Research indicates that when disaster response efforts are not inclusive, vulnerable populations are left behind, resulting in increased long-term socioeconomic disparities (ADB, 2022). The Multidimensional Poverty Index (MPI) provides a comprehensive framework for assessing poverty by considering various deprivations such as health, education, and living standards. This broader perspective allows stakeholders to identify at-risk communities more accurately and tailor interventions that address their specific needs (UNDP, 2023). By integrating the MPI into assessments of flood damage, policymakers can enhance recovery efforts and foster resilience against future disasters by empowering communities through targeted support and resources. Therefore, addressing the intersection of multidimensional poverty and flood risk is essential for developing effective disaster management strategies that promote equity and sustainability in Melamchi. These natural disasters cause a great deal of loss and destruction in the Melamchi Municipality, Sindhupalchowk in Nepal, an area that frequently floods. The population's socioeconomic weaknesses, especially those of the poor, make flooding a worse problem. The objective of this research is to evaluate the effects of flooding on the community by utilizing the poverty index as a lens to comprehend the degree to which flood events disproportionately affect impoverished households.

1.3 Research Questions

- a) What is the flood induced loss and damage in 6, 10 and 11 wards of Melamchi Municipality?
- b) What is the poverty status of 6, 10 and 11 wards before and after the recent 2021 flood in Melamchi Municipality?
- c) What is the co-relation between flood induced loss and damage and poverty of 6, 10 and 11 wards in Melamchi Municipality?

1.4 Objectives of the study

1.4.1 General Objective

To assess the flood induced loss and damage by using Multidimensional Poverty Index in Melamchi Municipality (ward no. 6, 10 and 11), Sindhupalchowk.

1.4.2 Specific Objectives

- a) To assess the flood induced loss and damage in 6, 10 and 11 wards of Melamchi Municipality by using MPI.
- b) To study the poverty status of 6, 10 and 11 wards before and after the recent 2021 flood in Melamchi Municipality.
- c) To co-relate the flood induced loss and damage with MPI.

1.5 Rationale of the study

The Multidimensional Poverty Index (MPI) is increasingly recognized as a valuable tool for assessing the impacts of floods, as it captures a wide range of deprivations beyond income, including health, education, and living standards. This multidimensional approach is particularly pertinent in post-disaster scenarios where individuals experience significant losses in assets, livelihoods, and access to essential services. For instance, the United Nations Development Programme (UNDP) emphasizes that the MPI can provide a more nuanced understanding of poverty in the aftermath of disasters, allowing for better-targeted recovery efforts (UNDP, 2021). Additionally, research indicates that using the MPI can help identify vulnerable populations who may be disproportionately affected by floods, thereby informing policies aimed at reducing inequalities and enhancing resilience (Alkire et al., 2015). By employing the MPI, policymakers can effectively address the complex realities faced by affected communities and implement strategies that support comprehensive recovery and development.

The selection of Melamchi Municipality is further justified by its geographical and socio-economic context. Located at the confluence of the Melamchi and Indrawati rivers, the area is prone to flooding due to its topography and hydrological characteristics. The catastrophic flood of June 2021 caused extensive damage to infrastructure and livelihoods, displacing hundreds of families and highlighting the municipality's vulnerability to climate change (ADB, 2021). Such events underscore the necessity of understanding how disasters affect various dimensions of poverty among different socio-economic groups within the municipality. By focusing on Melamchi, this study aims to provide insights that can inform disaster risk management strategies tailored to the unique challenges faced by urbanizing areas in Nepal.

The Melamchi Municipality has undertaken several action-oriented studies on floods; however, there remains a significant gap in scholarly research focusing on loss and damage through the lens of the Multidimensional Poverty Index (MPI). This study is essential for bridging that gap, as it will provide a comprehensive assessment of loss and damage that previous research has overlooked. The MPI allows for a nuanced understanding of poverty by evaluating various deprivations, including health, education, and living standards, which are crucial in understanding the full impact of floods on communities. By assessing loss and damage using the MPI, stakeholders can gain insights into the scope, magnitude, and location of destruction, which is vital for effective planning and response strategies. Furthermore, in the context of climate change, this approach will aid in addressing, evaluating, and mitigating the risks associated with flood-induced loss and damage. Research indicates that floods disproportionately affect the most vulnerable populations, exacerbating existing inequalities and pushing millions further into poverty (World Bank, 2022; ADB, 2022). Thus, employing the MPI not only enhances our understanding of the socio-economic impacts of flooding but also informs targeted interventions aimed at building resilience within affected communities (Nature Communications, 2022).

1.6 Limitations of the study

- Wards other than 6,10 and 11 were not studied.
- Rainfall and temperature data were not assessed.

CHAPTER 2

LITERATURE REVIEW

2.1 Global Context

Damage and death from floods were used to validate social vulnerability indicators. It was carried out using secondary data from the census and other US websites. Regression models were also utilized, with the social vulnerability index coming last. In the USA, floods caused mortality and devastation, which affected social vulnerability. Furthermore, in forecasting non-coastal flood death and damage, social vulnerability models associated with particular risks and outcomes outperformed generic social vulnerability indices (e.g., SoVI). Subsequent validation research also looked at other flood outcomes at different scales, including migration, evacuation, and health (Tellman et al., 2020).

The 2015 Flood's immediate consumption and poverty levels were evaluated. A household budget survey was used to acquire the information. The data was analyzed using the DID (Difference in Difference) Approach, mean, and S.E. to ensure that it was consistent with the goals. In the short term, consumption decreased dramatically, by 11–17%. The flood also caused a six-percentage point increase in poverty (Salvucci & Santos, 2020).

Flooding poses a significant threat to communities worldwide, particularly in vulnerable regions like the Lower Nyando Basin in Kisumu County, Kenya. The study "Loss and Damage from Flooding In Lower Nyando Basin, Kisumu County, Kenya" by Masese, Neyole, and Ombachi (2016) examines the adaptation mechanisms employed by households in response to flood risks. According to the authors, a substantial 71.1% of respondents reported being affected by floods, leading to severe consequences such as damage to furniture and hardware, which exacerbates poverty and vulnerability among affected communities. The study identifies several key adaptation strategies: 91.5% of respondents relocate family members and valuable goods to safer locations during floods, while approximately 83.3% construct flood diversion trenches to protect their properties. Additionally, about 58.3% seek relief from government agencies and NGOs during crises, highlighting the importance of institutional support in disaster response. The findings indicate a shared recognition among both government entities and households regarding the seriousness of flooding issues in the region, which is crucial for fostering collaborative efforts toward effective flood risk management (Neyole & Ombachi, 2016).

The integration of Earth Observation (EO) and census data presents a promising approach for quantifying and mapping the social components of vulnerability, particularly in regions frequently affected by floods. A methodology has been proposed that allows for the customization of assessments to create a dynamic Food Vulnerability Index (FVI), which aggregates adaptive capacity, coping capacity, and susceptibility. This approach is particularly relevant in areas like Northeast Italy, which has experienced significant urban and economic development over recent decades, necessitating a thorough understanding of evolving vulnerabilities. The analysis conducted from 1991 to 2016 at five-year intervals demonstrates how the combination of various data sources can yield a comprehensive assessment of vulnerability. Such insights are crucial for effective planning aimed at climate change adaptation and disaster risk reduction, highlighting the importance of integrating diverse datasets to inform policy and support vulnerable communities in flood-prone regions (Fabio & Mattia, 2021).

The vulnerability of impoverished populations to climatic disasters, particularly floods and droughts, is a pressing global concern, especially in urban areas across Africa. An analysis of household survey data and hydrological riverine data from 52 countries reveals that poor communities are often disproportionately exposed to these hazards. While the overall patterns of exposure remain relatively stable under various future climate scenarios, the absolute number of individuals at risk can vary significantly based on specific regional conditions and climate projections. This research highlights a critical issue in many African countries, where disadvantaged populations face heightened exposure to floods and droughts, underscoring the urgent need for targeted disaster risk reduction strategies. By addressing the unique challenges faced by these vulnerable groups, policymakers can better mitigate the impacts of climatic events. This intersection of disaster risk, climate change, and poverty emphasizes the importance of proactive measures to support at-risk communities and enhance their resilience in the face of ongoing environmental changes (HC & PJ, 2018).

2.2 Regional Context

Impacts of flooding on poverty, economic standing, and way of life were investigated. A household survey was used to get the information. To ensure that the data aligned with the goals, logistic regressions and cross-tabulation were used to examine the data. A 1% increase in floods caused livelihood and economic status to decline by 0.44% and 0.31%, respectively.

A 1% increase in flooding resulted with a 1.947% rise in family poverty. Poverty increased as a result of the financial losses brought on by livestock and crop destruction (Khayyam, 2020). In the Karnataka district of Bagalkot, the effects of floods on farmer's livelihoods and farm revenue were examined, with particular attention paid to the years 2019 and 2020. A household survey was used to get the information. To ensure that the data was consistent with the goals, descriptive statistics were used to assess the data. The sample households suffered an average loss of Rs. 8,55,540 in 2019 from all sources. Of that amount, the government compensated them with Rs. 99,222, or 11.59 percent of the total loss. The average loss suffered by the respondents in 2020 was Rs. 4,05,373, of which only Rs. 41,277 (or 10.18% of the total cost) was compensated by the state government (Phuong et al., 2023).

The study "A Local Level Relationship Between Floods and Poverty: A Case in Myanmar" by Akiyuki Kawasaki, Genki Kawamura, and Win Win Zin (2020) explores the intricate relationship between floods and poverty in Bago City, Myanmar. Utilizing a questionnaire survey and employing regression analysis, multi-regression analysis, and spatial analysis, the authors found that poor populations tend to reside in flood-prone areas, which significantly increases their vulnerability to flooding. The findings indicate that floods not only cause immediate damage but also exacerbate existing poverty levels, highlighting that those who suffer the most from flood events are often those living in the worst conditions. This research underscores the critical need for targeted interventions to address the vulnerabilities of impoverished communities in flood-prone regions. Published in the *International Journal of Disaster Risk Reduction*, this study contributes valuable insights into the socio-economic impacts of flooding and emphasizes the importance of integrating disaster risk reduction strategies with poverty alleviation efforts to enhance community resilience (Kawasaki & Zin, 2020).

The impact of floods on farm income and livelihoods is a critical concern in agricultural regions, particularly in Bagalkot District of Karnataka, India. A recent study analyzed the economic losses incurred by farmers during the flood events of 2019 and 2020, revealing significant financial hardships. In 2019, the average loss per household was reported at Rs. 8,55,540, while government compensation amounted to only Rs. 99,222, covering just 11.59% of the total loss. The situation remained dire in 2020, with average losses of Rs. 4,05,373 and compensation dropping to Rs. 41,277, which accounted for only 10.18% of the losses. These findings

highlight the inadequacy of governmental support in addressing the financial impacts of flooding on farmers' livelihoods and underscore the need for more effective disaster response strategies to enhance resilience in flood-prone agricultural areas (Murigeppa & Kanavalli, 2024).

The socio-economic vulnerability of communities to flooding is a critical concern in Lampung, Indonesia, as highlighted by a study assessing flood locations and associated economic losses. This research, conducted across 21 units in eight sub-districts of Pringsewu District, employs household surveys alongside secondary data from the Regional Disaster Management Agency (BPBD) and the Central Statistics Agency (BPS). Utilizing the Livelihood Vulnerability Index (LVI), LVI-IPCC approach, and the ECLAC method, the study classifies the vulnerability of the Lampung community to floods as high. Economic losses due to flooding were documented, with damage in the livestock sector accounting for 0.5% and in fisheries for 0.11% of total losses. Overall, these damages were relatively low at 0.16% of the Gross Regional Domestic Product (GRDP). The findings underscore the need for targeted interventions to enhance community resilience against flooding, emphasizing the importance of understanding socio-economic factors in disaster risk management (Chayyani & Gravitiani, 2020).

The economic impacts of flooding on different communities are profoundly influenced by socioeconomic factors, as demonstrated in a local-scale analysis conducted in Rathnapura, Sri Lanka. This study examines the disparities in economic loss between poor and non-poor households, revealing that during severe floods, poor households experience an absolute loss that is 48% of the loss incurred by their non-poor counterparts. Even during minor floods, the economic impact remains significant, with poor households facing 10% of the losses experienced by non-poor households. The findings indicate that severe flooding exacerbates the economic gap between these two cohorts, highlighting the vulnerability of impoverished communities in the face of natural disasters. By employing household surveys and advanced statistical methods such as path analysis and maximum likelihood estimation, this research underscores the critical need for targeted disaster risk reduction strategies that consider socioeconomic disparities (Silva & Kawasaki, 2020).

2.3 National Context

During a natural disaster, the economic damage was evaluated. Before and after a natural disaster, the distribution of income was evaluated. The indicated policy recommendations' concerns were made. The Sotkhola river basin and its catchment areas in western Nepal's Surkhet region were the subject of the study. To get the data, a household survey and secondary data sources were used. Prior to the natural calamity, the national inequality line (0.33) was less than the poverty and inequality levels in the water shed areas. The study area was susceptible both geographically and socioeconomically. Vulnerable households experienced a decline in their assets, inadequate food grains, and an increase in poverty and inequality (Bista, 2020).

It was determined how vulnerable the community's means of subsistence were in the upstream, midstream, and downstream sections of the southern Bagmati River corridor in Nepal. The southern portion of the Terai's Bagmati corridor, which includes the districts of Sarlahi and Rautahat, served as the study area. Utilizing the Household Survey, KII, and FGD, data was gathered. LVI-IPCC: The IPCC framework approach was used to assess the data to make sure it was consistent with the goals. The community residing in the downstream belt had the greatest livelihood vulnerability index values (0.528). The neighborhood downstream was the most susceptible to flooding. According to Shreevastav et al. (2021), the population residing in the upstream belt area was the least vulnerable (0.323) (Shreevastav et. al., 2021).

The vulnerability of the Tharu community in Western Nepal to flooding is a significant concern, particularly in the context of frequent monsoon floods that impact their livelihoods. Research indicates that Tharu households, primarily located in the Thapapur Village Development Committee (VDC) of Kailali district, face considerable risks due to their reliance on subsistence agriculture and small landholdings, which are often exacerbated by limited income diversification. While improved access to mobile technology has enhanced flood warning systems and reduced human casualties, agricultural losses remain substantial. The study highlights that improper resettlement of marginalized ex-bonded laborers and land fragmentation due to family separations contribute significantly to vulnerability. Furthermore, agricultural land serves not only as a crucial natural asset but also as a financial resource, underscoring its importance in the community's economic stability. These findings emphasize the need for targeted flood management strategies that address the unique challenges faced by

the Tharu people, particularly in enhancing their adaptive capacity and resilience against future flooding events (Sharma & Gautam, 2022).

This study examines headship-based household vulnerabilities in the Koshi River Basin of Nepal, focusing on four communities: Barahakshetra, Mahedranagar, Shripur, and Haripur in the Sunsari district. Utilizing a combination of household surveys, key informant interviews, focus group discussions, and in-depth interviews, the research employs various analytical techniques, including composite indices and the Social Vulnerability Index (SVI), to assess social, economic, environmental, and physical vulnerabilities. The findings reveal that female-headed households (FHHs) are more vulnerable across all components of the assessment. Furthermore, sociocultural norms are identified as significant factors driving the disparities that affect households' abilities to respond to and recover from flood disasters, ultimately impacting disaster risk reduction (DRR) processes. This research underscores the critical need for gender-sensitive approaches in disaster management strategies to enhance resilience among vulnerable populations in flood-prone areas (Guragain & Doneys, 2022).

This study investigates the flood-induced loss and damage to agricultural crops in Rajapur Municipality, Bardiya District, Nepal, with a focus on analyzing the trends of flood events in the Karnali River, assessing the economic impacts on farmers, and exploring their coping mechanisms. Utilizing a combination of field visits, household surveys, questionnaires, key informant interviews, focus group discussions, and secondary information, the research employs descriptive statistics and graphical representation for data analysis. The findings reveal significant economic losses across different categories of farmers: small farmers incurred a total loss of \$21,709.77, medium farmers faced losses of \$50,225.24, and large farmers experienced losses amounting to \$32,393.49. Overall, the total production loss was calculated at \$45,888.77. This study highlights the vulnerability of the agricultural sector to flooding and underscores the urgent need for effective coping strategies and support mechanisms to mitigate the impacts of such disasters on farmers' livelihoods in flood-prone areas (Poudel, 2022).

The National Planning Commission's 2021 report on Nepal's Multidimensional Poverty Index (MPI) provides a comprehensive analysis of poverty trends, revealing significant progress in reducing multidimensional poverty from 30.1% in 2014 to 17.4% in 2019, lifting approximately 3.1 million people out of poverty (NPC, 2021). Despite this progress, the report highlighted those 4.9 million individuals remained multidimensionally poor, with notable disparities

between rural (28%) and urban (12.3%) areas. Provincial variations were evident, with Karnali Province showing the highest poverty rate at 39.5%. Key deprivation indicators included inadequate housing materials, lack of clean cooking fuel, insufficient years of schooling, and nutritional deficiencies, with education and nutrition being the most significant contributors to ongoing poverty. Nepal's MPI value of 0.074 positioned it favorably compared to many South Asian nations, though the report emphasized the adverse impacts of COVID-19 on existing deprivations. Importantly, the study noted that most poor individuals could exit poverty by addressing just one or two deprivations, suggesting potential for targeted interventions to further reduce multidimensional poverty (NPC, 2021). This comprehensive analysis serves as a crucial resource for policymakers in designing effective strategies to alleviate poverty and improve living conditions across Nepal.

The relative analysis of flood tide impacts and damages caused by major trans-boundary gutters in Nepal highlights the significant challenges posed by these natural disasters. Focusing on four crucial rivers: Koshi, Kamala, Narayani, and West Rapti. This study employs secondary data from the Department of Hydrology and Meteorology (DHM) and utilizes Multi-Criteria Decision Making (MCDM) styles, including the Simple cumulative Weighting (aphorism) system and Shannon entropy. The assessment examines 13 parameters related to flood tide impacts, similar as mortal casualties, injuries, property loss, socio-profitable goods, and damage to physical structure. Findings reveal that the Koshi River has historically foisted the loftiest situations of loss and damage to both mortal lives and property, followed by the Kamala, Narayani, and West Rapti river. These ranking underscores the critical need for targeted flood tide operation strategies acclimatized to the specific vulnerabilities associated with each swash system. By illuminating the varying degrees of impact across these trans-boundary gutters, the exploration emphasizes the significance of comprehensive disaster threat reduction measures to alleviate unborn flood tide-affiliated losses in Nepal (Kafle, 2020).

2.4 Local Context

Both economic and non-economic loss and damage were assessed. The quantification of estimated loss and damage (L&D) to determine the cost incurred by the communities. Evidence to support the need for funding for L&D in order for it to be included in the developed national and international financial framework. Melamchi Municipality and Helambu Rural Municipality served as the study areas. Data were gathered from the Household Survey, KII,

FGD, and secondary sources. In order to determine whether the data was congruent with the objectives, case analysis, cost estimation, and box storytelling were utilized. An almost USD 5 million economic loss was discovered among 120 responders. The flood caused an average household's economic losses to be USD 52,113. A 58% of respondents said that the floods harmed their cultural and religious sites, 51% said that it greatly affected their social interaction, 41% highlighted gender-specific impacts, and 85% reported mental health concerns. 73% also emphasized the impact on education (Parajuli et al., 2023).

The 1-D hydraulic HEC- HMS model was used to prognosticate indigenous inflow during both flood tide occurrences. We looked at the relationship between temperature and snow water fellow and downfall and runoff. The Melamchi- Indrawati milepost served as the study area. Primary styles of data collection included field checks and drone checks; secondary sources included data from ICIMOD, DHM, and NDRRMA. The data was anatomized using the HEC-RAS and HEC- HMS models to ensure that they were harmonious with the pretensions. From 1992 to 2021, the Melamchi region endured 2610 mm of monthly downfall on average. The first and alternate events at Melamchi Bazar had a discharge of 2893 m³/ s and 1105 m³/ s, independently. Melamchi, Chanaute, and Kiwil contributed significantly to the diurnal average snow water fellow of 672 mm in the upper receptacle, which has the implicit to melt out in response to rising temperatures (Baniya et al., 2024).

This study provides a comprehensive overview of being information and knowledge related to flood tide preparedness, response, and recovery in colorful regions affected by the Melamchi flood tide, including Sindhuplachok, Doti, Saptari, Kavre, Gorkha, Jumla, Arghakhanchi, Palpa, Kaski, Kalikot, and Bajura. exercising secondary data from multiple spots and assaying it through MS- Excel, the exploration highlights that effective perpetration of threat operation styles necessitates original planning and coordinated resource- participating enterprise among civil, parochial, and external parties. still, the study reveals a significant lack of similar coordinated sweats in Nepal, which hampers the overall effectiveness of flood tide response strategies. This exploration underscores the critical need for bettered collaboration among different situations of government to enhance flood tide preparedness and adaptability in vulnerable communities (Koirala, 2021).

The rudiments of multi-hazard threat knowledge and the established protocols were assessed. acclimatized programs to enhance complete early warning systems and connect last- afar heirs were set up by exercising the institutional coffers of the megacity. The exploration area was the megacity of Melamchi in Sindhupalchowk, Nepal. The data was collected using the Household Survey, KII, and FGD. Excel was employed to estimate the data and ensure that it aligned with the objectives. A politic road chart promoting enhanced communication styles. the establishment of a thorough early warning system, community- powered panels, frequent training sessions, and backing support (Dulal & Regmi, 2024).

The relationship between land use changes and flooding is a critical area of exploration, as differences in land cover significantly impact hydrological dynamics and the inflexibility of flood tide impacts. colorful studies emphasize that urbanization, deforestation, and agrarian practices can complicate flood tide pitfalls by reducing soil infiltration capacity and altering natural drainage patterns. For case, exploration indicates that land cover changes, similar as the conversion of timbers to agrarian or civic areas, lead to increased flood tide frequence and intensity due to lowered foliage cover and increased runoff. In Nepal, a study on the Melamchi- Indrawati swash receptacle highlights the dramatic impacts of a severe flood tide event on land use, revealing a 90.48 reduction in agrarian land and significant losses in timber cover. This aligns with broader findings that effective land use planning is essential for mollifying flood tide pitfalls and enhancing community adaptability. By employing advanced remote seeing technologies and methodologies like the arbitrary timber classifier, experimenters can directly assess changes in land use over time, furnishing precious perceptivity for disaster threat operation strategies. The integration of these findings underscores the necessity for sustainable land operation practices that consider the long- term counteraccusations of land use on flood tide vulnerability, particularly in fleetly citifying regions (Thapa & Prasai, 2022).

Flood hazard mapping is essential for effective disaster operation and threat reduction, particularly in areas prone to severe flooding. exploration indicates that employing amulti- criteria decision analysis (MCDA) approach can significantly enhance the delicacy and trustability of flood tide hazard charts. Factors similar as the Topographical Wetness Index (TWI), elevation, pitch, rush, land use/ land cover (LULC), and foliage indicators are critical in assessing flood tide vulnerability. A recent study fastening on the Indrawati River Basin in

Nepal employed the Analytic Hierarchy Process (AHP) to estimate these factors and classify the area into colorful flood tide vulnerability zones. The findings revealed that 13 of the receptacles is classified as veritably low flood tide vulnerability, while 8 falls into the veritably high order, with an Area Under the wind (AUC) value of 0.792 indicating good prophetic capability. This exploration highlights the significance of scientifically valid flood tide hazard maps for informing early warning systems and flood tide threat reduction measures, eventually abetting original authorities and communities in better preparing for flood tide events. By integrating advanced methodologies and comprehensive data analysis, similar studies contribute significantly to enhancing adaptability against flooding in vulnerable regions (Subedi & Shrestha, 2023).

The impact of climate- convinced disasters on communities is a pressing issue, particularly in regions like Sindhupalchowk District, Nepal, where similar events have profound counteraccusations for mortal lives and original husbandry. An analysis of data from the Nepal Disaster Risk Reduction (NDRR) portal covering the period from 1971 to 2022 reveals that climate- convinced disasters have affected over 100,000 families, performing in significant casualties, including 4,467 deaths and 2,778 injuries. specially, the study indicates that 53 of the total death risk is attributed to climate- convinced disasters, while 47 results from non-climate-related events. The profitable impacts are inversely intimidating, with estimated damages and losses amounting to roughly Nepalese rupees. This exploration underscores the critical need for effective disaster threat operation strategies acclimatized to address the unique challenges posed by climate change. By using secondary data analysis ways, the study provides precious perceptivity into the long- term impacts of climate- related events on vulnerable populations, emphasizing the significance of preparedness and adaptability- structure measures in disaster-prone areas (Pariyar, 2022).

CHAPTER 3

MATERIALS AND METHODS

3.1 Study Area

Melamchi is a Municipality in Sindhupalchok District in the Bagmati Province of central Nepal which extends from 27.8297° N latitude and 85.5762° E longitude on the world map. Melamchi Municipality, located in the Sindhupalchok District of Nepal, was established in 2015 through the integration of several village development committees. Covering an area of 158.16 square kilometers, it constitutes approximately 6.315% of the district's total area. The municipality is bordered by Indrawati and Panchpokhari Rural Municipalities to the east and Shankharpur Municipality of Kathmandu to the west. Melamchi is divided into 13 wards, each reflecting a rich cultural heritage influenced by both Hindu and Buddhist traditions, with numerous temples and monasteries present throughout the region (Nepal Government, 2021; Thapa, 2022).

As of the 2021 census, Melamchi Municipality had a population of approximately 41,063 residents, highlighting a diverse demographic composition. The region experiences a sub-tropical climate in its lower areas and a cooler temperate climate at higher elevations, with significant rainfall during the monsoon season. Melamchi is renowned for its natural beauty, featuring extensive forested areas that include parts of Shivpuri Nagarjuna National Park, making it an attractive destination for eco-tourism and outdoor activities (Namaste Sindhupalchowk, 2022; Nepal Archives, 2022; CollegeNP, 2022). The municipality's geographical features and climate contribute to its agricultural productivity, with a substantial portion of land designated for cultivation. The average annual temperature is around 20.8 degrees Celsius, with the region receiving heavy rainfall during the monsoon months, which supports the growth of various crops and enhances its appeal as an eco-tourism destination (Namaste Sindhupalchowk, 2022; CollegeNP, 2022).

Among the 13 wards of Melamchi Municipality 6, 10 and 11 were chosen for the study area. And the population distribution of these 3 wards are as follows:

Table 1: Ward-wise Population Distribution

| S.N. | Name of Wards | Ward Number | Population |
|------|---------------|-------------|------------|
| 1 | Talamarang | 6 | 3141 |
| 2 | Shikharapur | 10 | 2564 |
| 3 | Melamchi | 11 | 5,230 |
| | | Total | 10935 |

(NSO, 2021)

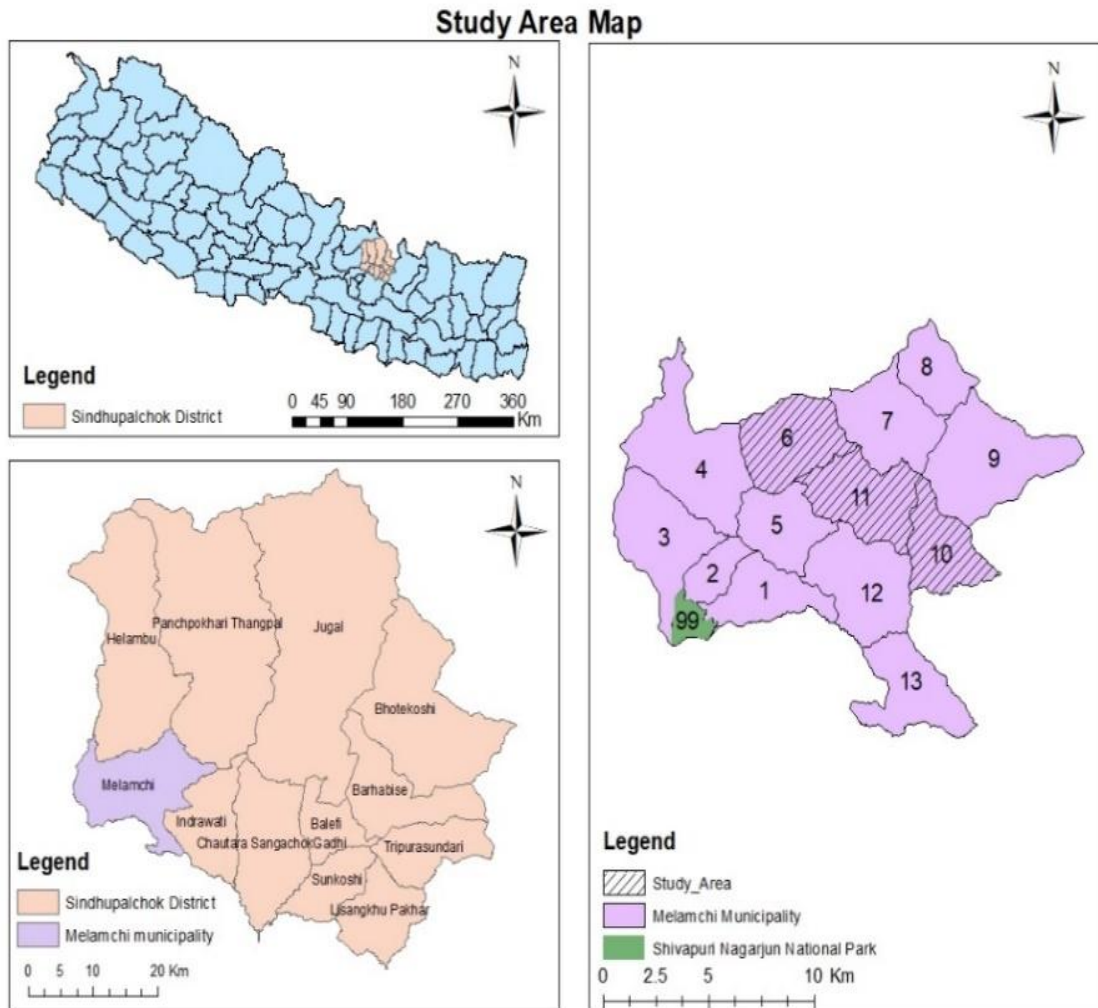


Figure 1: Study Area

3.2 Research Design

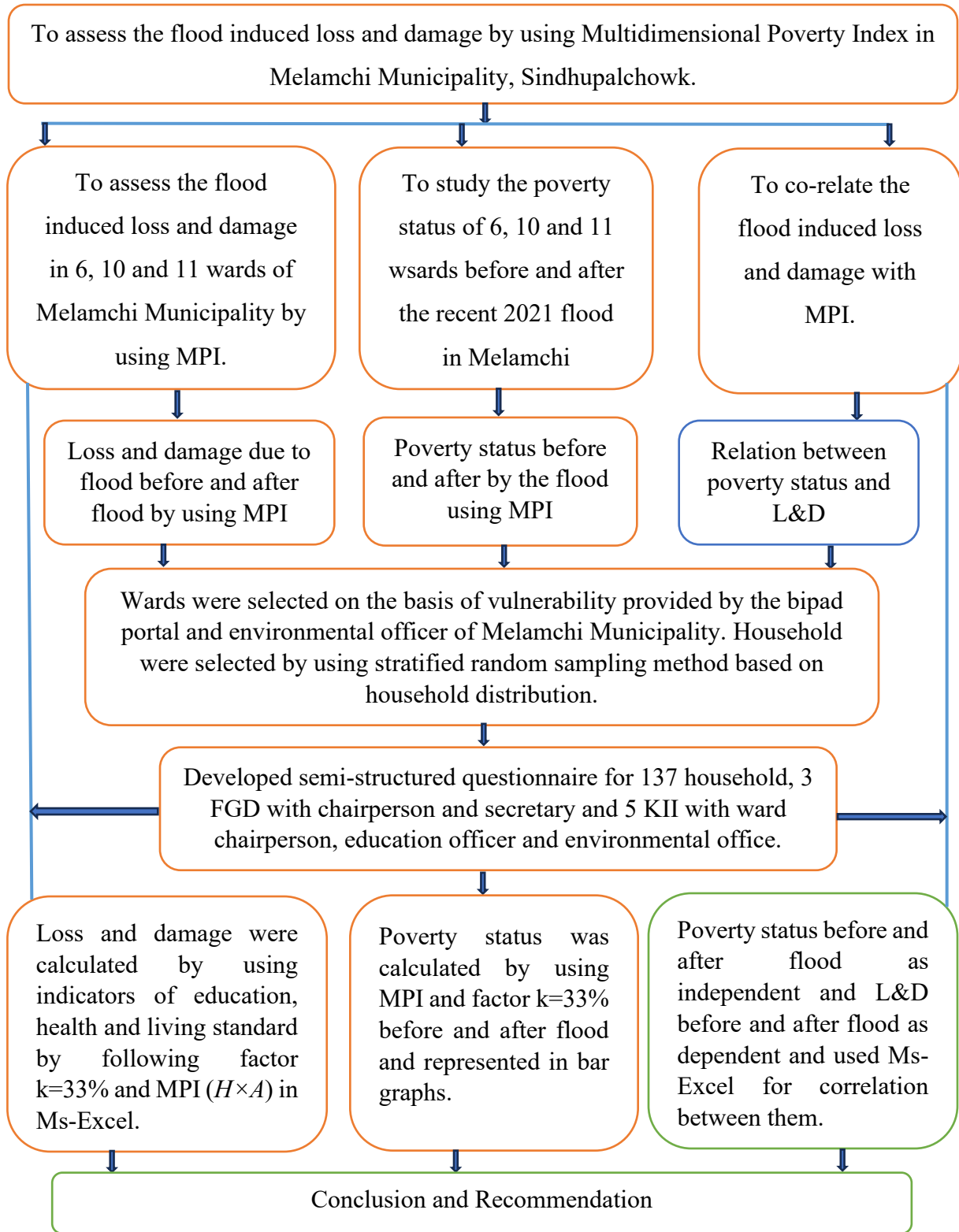


Figure 2: Research Design

3.3 Objective Wise Research Matrix

Table 2: Objective Wise Research Matrix

| S.N. | Objectives | Variables | Methods of Data collection | Analysis |
|------|--|-----------------------------------|---|--|
| 1 | To assess the flood induced economic loss and damage in 6, 10 and 11 wards of Melamchi Municipality. | Loss and Damage data | FGD, KII and Secondary Sources (Municipal Office) | Multi-Dimensional Poverty Index, Excel |
| 2 | To study the poverty status of 6, 10 and 11 wards before and after the recent 2021 flood in Melamchi Municipality. | Previous and current Poverty data | Household Survey, FGD and KII | Multi-Dimensional Poverty Index, Excel |
| 3 | To co-relate the flood induced economic loss and damage with poverty. | MPI and Loss & Damage data | Household survey, FGD, KII and secondary sources | Excel, SPSS and R-studio |

3.4 Sampling Strategy

The multi-stage sampling approach was used to carried out the sampling. First, purposive sampling is carried out on the basis of vulnerability to the flood, and only the most and extremely susceptible wards 6, 10 and 11 are selected. Then, the stratified sample method is applied in accordance with the ward.

3.4.1 Sample Size Selection

Sample size was calculated using Cochran's formula,

$$n_o = Z^2 pq / e^2$$

Where:

Z= statistical value corresponding to level of confidence required (1.96)

p= the (estimated) proportion of the population which has the attribute in question (0.90)

q= 1 – p (0.10)

e= the margin of error (7%)

Modification for the Cochran Formula for Sample Size Calculation in Smaller Populations

$n = \lceil n_0 / (1 + \{(n_0 - 1) / N\}) \rceil$.

Where:

n_0 = Cochran sample size

N= Total population on selected ward

n= sample size

In total 137 household were selected from wards 6,10 and 11. Required data and information were collected from all these households.

3.4.2 Sample Size

The Melamchi Municipality, Bipad portal and PRC report 2023 identified wards 6, 10, and 11 as particularly vulnerable to flooding, emphasizing the need for targeted interventions based on multidimensional poverty metrics. These wards were selected due to their heightened exposure to flood risks, which have been exacerbated by factors such as climate change and inadequate infrastructure development.

After that simple random sampling (SRS) allowed each individual in a population of 10,935 to have an equal opportunity for selection, ensuring that the sample accurately reflected the larger group. To establish the sample size, the total population (N) was identified as 10,935, and a target sample size (n) of 137 was determined to ensure reliable results. The selection process typically employed random number generators method to maintain unbiased sampling.

Sample size (ss) = (total household in a ward / total household in the municipality) × n

Table 3: Adjusted Sample Size

| S.N. | Wards | Stratified Sample Size | Adjusted Sample Size |
|------|----------------|------------------------|----------------------|
| 1 | Talamarang,6 | 39.35 | 39 |
| 2 | Shikharapur,10 | 32.12 | 32 |
| 3 | Melamchi, 11 | 65.52 | 66 |
| | | Total | 137 |

3.5 Research Methods

This study comprises primary and secondary method.

3.5.1 Primary Method

a) Household Survey

Stratified random sample techniques was used to collect data from the listed wards (6, 10 and 11). Information from the respondents were gathered via a semi-structured questionnaire. There was a survey of 137 households using the HH questionnaire. We anticipated that each interview was done between ten and twenty minutes. The purpose of household surveys was to collect data regarding the means of communication, the readiness to respond to warnings, and the impact of floods both before and after installation, including demographic information.

b) Focus Group Discussion

The initial phase was to identify the important parties, including disaster management specialists, local leaders, vulnerable populations, and government representatives from the area. The creation of a semi-structured discussion guide for focus groups was cover subjects like poverty-related harm, floods, loss and damage, and climate change. Focus Group Discussions (FGDs) were conducted separately with each stakeholder group such as Chairpersons of Municipal Level Disability Network and CDMC; Secretary of Fatte Community Forest to obtain a range of perspectives. The FGD results were analyzed to determine if flood damage and loss were correlated with poverty.

c) Key Informant Interview

The Melamchi Municipality's Education and Environmental officer and the ward chiefs of the 6, 10, and 11 wards were interviewed as key informants. Major poverty line prior to and following

the recent flood in 2021, as well as loss and damage caused by the flood, were gathered via this key informant consultation.

3.5.2 Secondary Method

Information was gathered via books, journals, websites, bipad portals, published and unpublished theses, and published and unpublished articles.

3.6 Data Analysis

3.6.1 Loss and Damage through Multidimensional Poverty Index

The Multidimensional Poverty Index (MPI) provides a nuanced perspective on loss and damage by illustrating the intricate connections among profitable, social, and environmental vulnerabilities. By assessing losses across colorful confines similar as health, education, and living norms, the MPI highlights populations that are particularly susceptible to climate-related shocks and stresses. This detailed examination reveals how extreme rainfall events, rising ocean situations, and other climate impacts consolidate pre-existing issues of poverty, inequality, and marginalization. Accordingly, the MPI serves as vital substantiation for enforcing targeted interventions and policy measures aimed at enhancing adaptability and easing recovery.

The computation of the MPI involves two main factors the prevalence of poverty (the proportion of the population linked as poor) and the intensity of poverty (the average position of privation endured by those who are poor). The MPI is mathematically represented as

$$MPI = H \times A$$

Where:

- H is the headcount rate, representing the proportion of the population that's multidimensionally poor.
- A is the intensity of poverty, indicating the average proportion of losses endured by those who are poor (Alkire & Jahan, 2018).

3.6.1.1 Indicators of MPI and their weightage

The assessment of poverty status using the Multidimensional Poverty Index (MPI) involved assaying data collected from colorful field styles. This data was attained through different approaches, including Household Survey, Focus Group Discussion, and Key Informant Interviews. Household surveys handed quantitative perceptivity into living conditions and

access to essential services, while Focus Group Discussions offered community perspectives on poverty. Key Informant Interviews supplied expert perceptivity and a deeper understanding of specific issues impacting poverty in the region. By integrating these colorful sources of information, the analysis aimed to present a thorough overview of poverty conditions and the contributing factors.

The indicators employed in the MPI included nutrition, child mortality, times of training, casing quality, and asset power. This frame captured the multiple confines of poverty, illustrating individualities' living conditions and available openings. The findings indicated significant scarcities particularly in casing quality and access to clean cuisine energy, with dearths in educational attainment and nutrition arising as major contributors to multidimensional poverty in Nepal. By espousing this comprehensive approach, policymakers were better equipped to identify vulnerable populations and develop targeted interventions (NPC, 2021).

Table 4: Indicators of MPI and their weightage

| Dimension | Indicator | Deprivation Criteria | Weight |
|------------------|---------------------|--|--------|
| Health | Nutrition | Any child for whom there's nutritive information is undernourished (light or suppressed). | 1/6 |
| | Child Mortality | A child under 18 has failed in the Family in the once five times. | 1/6 |
| Education | Year of Schooling | No Family member aged 11 times or aged has completed 6 times of training. | 1/6 |
| | School Attendance | Any academy-aged child isn't attending academy up to the age at which he she would complete class 8. | 1/6 |
| Living Standards | Cooking Fuel | Cuisine Energy The family culinarians with soil, wood, or charcoal. | 1/18 |
| | Improved Sanitation | The household's sanitation installation isn't bettered or is bettered but participated with other homes. | 1/18 |

| | | | |
|--|-------------------------|---|------|
| | Improved drinking water | The Family lacks access to bettered drinking water, or safe drinking water is at least a 30-minute roundtrip walk from home. | 1/18 |
| | Electricity | The household has no electricity. | 1/18 |
| | Housing | The Family uses shly accoutrements for any of the three factors bottom, roof, or walls. | 1/18 |
| | Assets Ownership | The household doesn't enjoy further than one of the following means radio, television, telephone, computer, beast wain, bike, motorbike, or refrigerator; and doesn't enjoy an auto or truck. | 1/18 |

(Source: CBS and OPHI,2021)

3.6.2 Poverty Status

The analysis of poverty utilized the Multidimensional Poverty Index (MPI) by integrating data collected through various methods such as household surveys, focus group discussions, and key informant interviews. Household surveys provided quantitative insights into living conditions and access to essential services, while focus groups and key informant interviews offered qualitative perspectives on community views and specific issues related to poverty, thus enabling a comprehensive understanding of the factors contributing to poverty in the area (Alkire, Kanagaratnam and Suppa, 2024). This multifaceted approach aimed to capture both the incidence and intensity of multidimensional poverty, reflecting the diverse deprivations experienced by individuals within the community (Dotter and Klasen, 2017).

3.6.3 Correlation between MPI and Poverty Status

The correlation between the Multidimensional Poverty Index (MPI) and poverty status was anatomized using both MS Excel and R- Studio, furnishing precious perceptivity into the relationship between these two important measures of poverty. This analysis involved calculating the MPI grounded on colorful pointers, similar as health, education, and living norms, and also comparing these results to traditional assessments of poverty status. Through the use of Excel, we were suitable to organize and manipulate the data effectively, allowing for a clear visualization of trends and patterns. R- Studio was also employed to conduct more

advanced statistical analyses, enabling the identification of both positive and negative correlations between MPI scores and poverty status. The findings revealed that in areas with high MPI values, there were frequently significant losses in multiple confines, indicating a strong positive correlation with severe poverty conditions. Again, some regions displayed lower MPI scores despite facing profitable challenges, pressing cases where income- grounded assessments didn't completely capture the complications of poverty. This comprehensive approach allowed experimenters to understand not only the connections between MPI and poverty status but also the diversions that could inform targeted policy interventions aimed at easing multidimensional poverty. Eventually, the analysis underlined the significance of using multidimensional measures to gain a deeper understanding of poverty dynamics in different surrounds.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Results

4.1.1 Demographic Distribution

In Melamchi Municipality, the distribution of respondents across Wards 6, 10, and 11 indicated differing levels of community engagement. Ward 6 recorded 39 respondents, suggesting a moderate level of participation in the surveys or assessments conducted in that area. Conversely, Ward 10 had a lower engagement with only 32 respondents, pointing to possible opportunities for enhancing community outreach and awareness. In contrast, Ward 11 had the highest participation, with 66 respondents, indicating greater involvement and potentially better access to the survey initiatives. The differences in respondent numbers among the wards underscored variations in socio-economic conditions, access to information, and community engagement strategies utilized in each ward, all of which are vital for effective local governance and development planning (UNFCCC, 2022). Recognizing these demographic trends was crucial for designing interventions that catered to the specific needs and challenges faced by each ward within Melamchi Municipality.

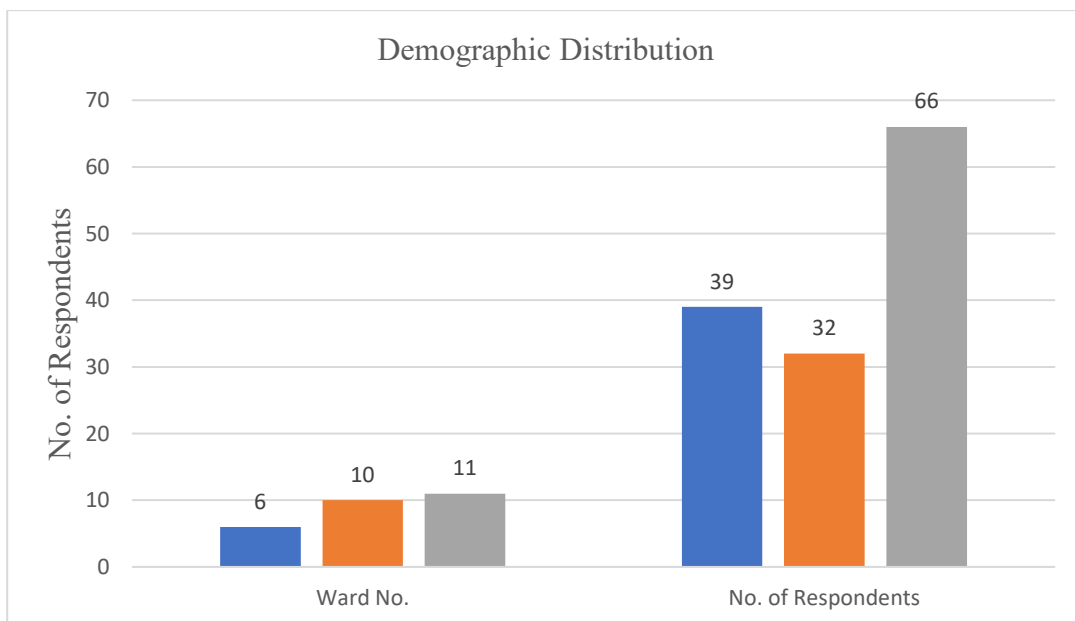


Figure 3: Demographic Distribution

4.1.2 Loss and damage

Instead of concentrating only on finance, the Multidimensional Poverty Index (MPI) takes into account a number of deprivations in health, education, and living conditions in order to assess poverty (Alkire & Santos, 2010). A number of 0.03 suggests that only 3% of people are considered to be multidimensionally poor, indicating a low level of multidimensional poverty within the population under assessment comparing before and after flood occurrence. In comparison to populations with higher MPI values, this classification indicates that these people face various deprivations at the same time, indicating comparatively improved living conditions and access to necessary services (UNDP, 2019).

4.1.3 Ward-wise MPI

4.1.3.1 Ward-wise MPI Before Flood

The Multidimensional Poverty Index (MPI) for Melamchi Municipality's Wards 6, 10, and 11 provides a detailed understanding of the poverty levels experienced by residents in these areas. Each ward's MPI reflects the extent of deprivation across various dimensions such as health, education, and living standards. Ward 6 had an MPI of 0.11, indicating a relatively low level of multidimensional poverty. This suggests that residents in this ward likely had better access to essential services, such as healthcare and education, compared to those in other wards. The lower MPI score signifies that fewer individuals in Ward 6 faced significant challenges in meeting their basic needs, pointing to a more favorable socio-economic environment. In contrast, Ward 10 recorded an MPI of 0.14, reflecting a higher level of poverty. This higher score indicates that residents may have encountered greater difficulties in accessing quality education, healthcare, and adequate living conditions. The challenges faced by this ward suggest a need for targeted interventions aimed at improving access to these essential services. Community programs focused on educational support or healthcare access could significantly enhance living standards for residents in Ward 10. Meanwhile, Ward 11 had an MPI of 0.12, placing it between Wards 6 and 10. Although it exhibited a better situation than Ward 10, it still indicated a significant level of multidimensional poverty that required attention. The MPI value for Ward 11 highlights the necessity for development strategies that address the specific needs of its residents.

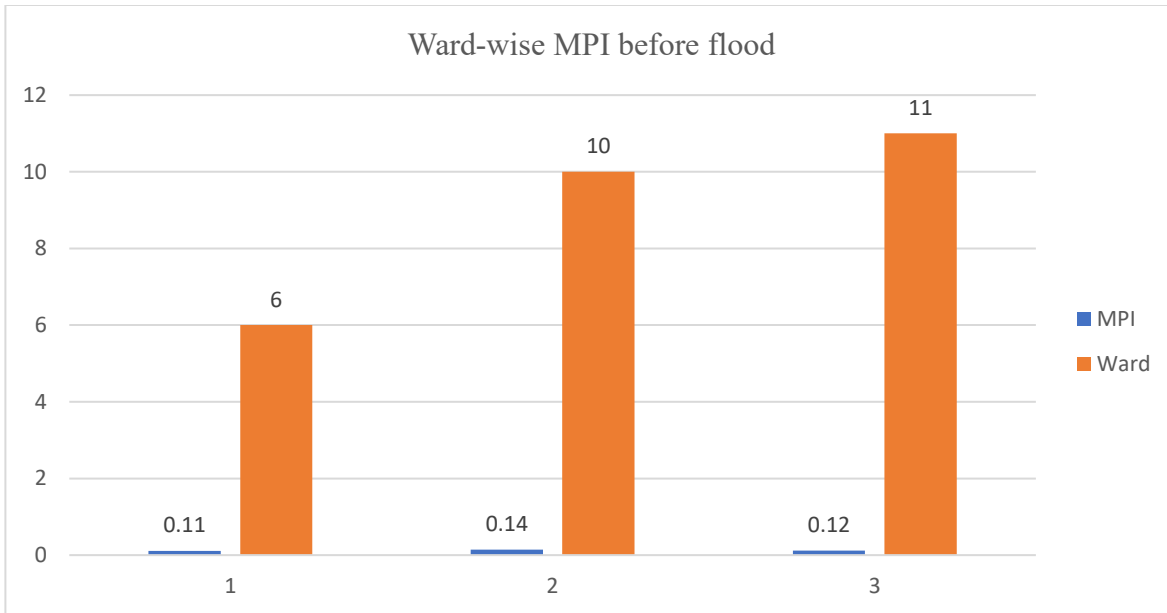


Figure 4: Ward-wise MPI Before Flood

4.1.3.2 Ward-wise MPI After Flood

The Multidimensional Poverty Index (MPI) was a tool used to measure poverty by looking at various aspects of people's lives, rather than just their income. In Melamchi Municipality, the MPI for Wards 6, 10, and 11 showed significant differences in the levels of poverty experienced by residents. Ward 6 had an MPI of 0.14, indicating a moderate level of poverty, which suggested that people there generally had better access to essential services like healthcare and education. In contrast, Ward 10 had a slightly higher MPI of 0.15, reflecting more challenges in accessing these services, meaning that residents might have struggled more with issues like health and education. Ward 11 stood out with an MPI of 0.27, indicating a high level of multidimensional poverty. This meant that many people in this ward faced multiple deprivations simultaneously, such as poor health, lack of education, and inadequate living conditions. The MPI helped policymakers understand not just how many people were poor but also the specific areas where they were lacking, enabling targeted efforts to improve their living conditions. Additionally, the MPI provided valuable insights into the effectiveness of social programs and interventions aimed at reducing poverty in these wards. By identifying the most pressing needs of the residents, local authorities could prioritize resources and create tailored strategies to address the unique challenges faced by each ward (Alkire & Santos, 2010; OPHI, 2023).

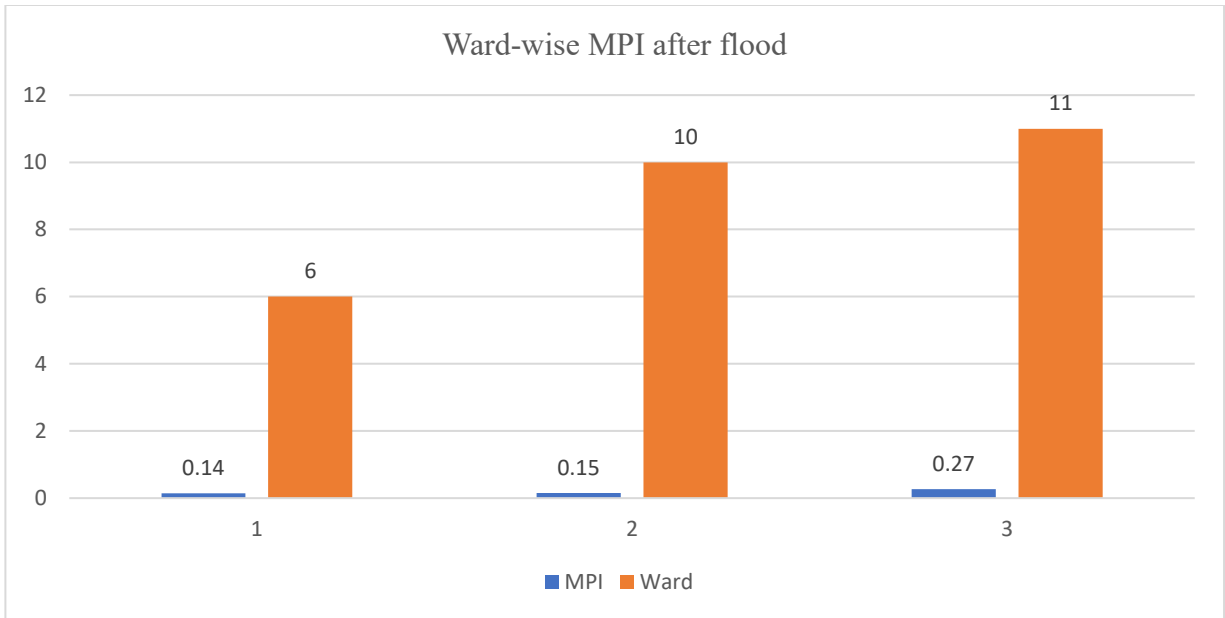


Figure 5: Ward-wise MPI After Flood

4.1.4 Incidence (*H*), Intensity (*A*) and Multidimensional Poverty Index

The floods that hit Melamchi Municipality in 2021 had a serious impact on poverty levels in the area, leading to noticeable changes in key poverty indicators. One important measure, the Multidimensional Poverty Index (MPI), increased from 0.12 to 0.15, which meant that more people were experiencing various forms of poverty. The Headcount Ratio, which showed the percentage of people living in poverty, rose significantly from 29.19% to 37.96%, representing an 8.77% increase. This rise suggested that many residents were pushed into poverty as a direct result of the floods (World Bank, 2022). Additionally, the Intensity of Poverty, which measured how deep the poverty was among those affected, also rose slightly from 39.68% to 41.62%, indicating that those already struggling with poverty faced even more severe hardships (Rentschler et al., 2020).

These changes highlighted how natural disasters could worsen the situation for vulnerable communities like those in Melamchi, especially in areas such as Sindhupalchowk, where the floods caused widespread damage (World Bank, 2022). The data showed that not only did more people fall below the poverty line due to the floods, but those who were already poor found their situations getting worse, making life even more difficult for them (Hallegatte et al., 2020). This situation reflected a pattern seen around the world: floods and other natural disasters often

hit low-income communities the hardest, pushing them further into poverty and making it much harder for them to recover (Nature Communications, 2022).

Table 5: Incidence (H), Intensity (A) and Multidimensional Poverty Index

| Index | Poverty Across time | | Changes |
|----------|---------------------|-------------|---------|
| | Before Flood | After Flood | |
| MPI | 0.12 | 0.15 | 0.03 |
| <i>H</i> | 29.19% | 37.96% | 8.77% |
| <i>A</i> | 39.68% | 41.62% | 1.94% |

4.1.5 Poverty Status

4.1.5.1 Poverty Status Before Flood

The categorization of respondents based on their perceived poverty status reveals significant insights into the economic conditions within the surveyed population. Among the respondents, 40 individuals identified themselves as having a High poverty status, while 39 respondents fell into the Medium category. Notably, the largest group consists of those classified as having a Low poverty status, comprising 58 respondents. This distribution highlights that a greater number of individuals perceive themselves as experiencing low levels of poverty compared to those in the high and medium categories. Such findings may suggest the effectiveness of ongoing poverty alleviation measures or improvements in economic conditions within the community. Understanding these perceptions is crucial for policymakers and social workers, as it can guide targeted interventions aimed at addressing the needs of those in higher poverty brackets. By focusing on improving conditions for those who feel they are in high or medium poverty, stakeholders can work towards reducing overall poverty levels and enhancing quality

of life for all individuals (Central Statistics Office, 2024; World Bank, 2024).

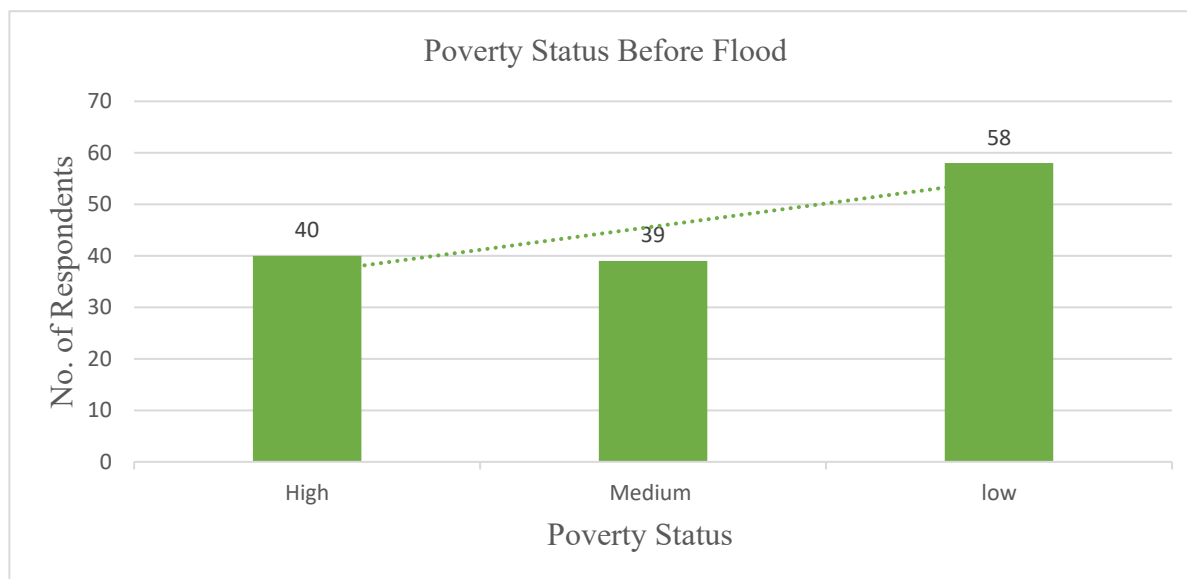


Figure 6: Poverty Status Before Flood

4.1.5.2 Poverty Status After Flood

The distribution of respondents based on their perceived poverty status reveals important insights into the economic conditions faced by individuals within the surveyed population. Among the respondents, a total of 52 individuals identified themselves as experiencing High poverty status, indicating a significant level of economic hardship. Meanwhile, 47 respondents categorized their situation as Medium, suggesting that they perceive their financial circumstances as somewhat challenging but not as severe as those in the High category. In contrast, the smallest group consisted of 38 respondents who perceived their poverty status as Low, indicating that they feel relatively secure in their economic situation compared to the other groups. This data clearly indicates that a substantial number of individuals feel they are facing considerable economic challenges, with more respondents identifying as being in High poverty compared to those in the Low category. Such findings underscore the ongoing struggles related to poverty and highlight the necessity for targeted interventions aimed at improving the economic well-being of those affected. Addressing these disparities is crucial for fostering a more equitable society and ensuring that all individuals have access to resources and opportunities that can enhance their quality of life (Central Statistics Office, 2024; World Bank, 2024).

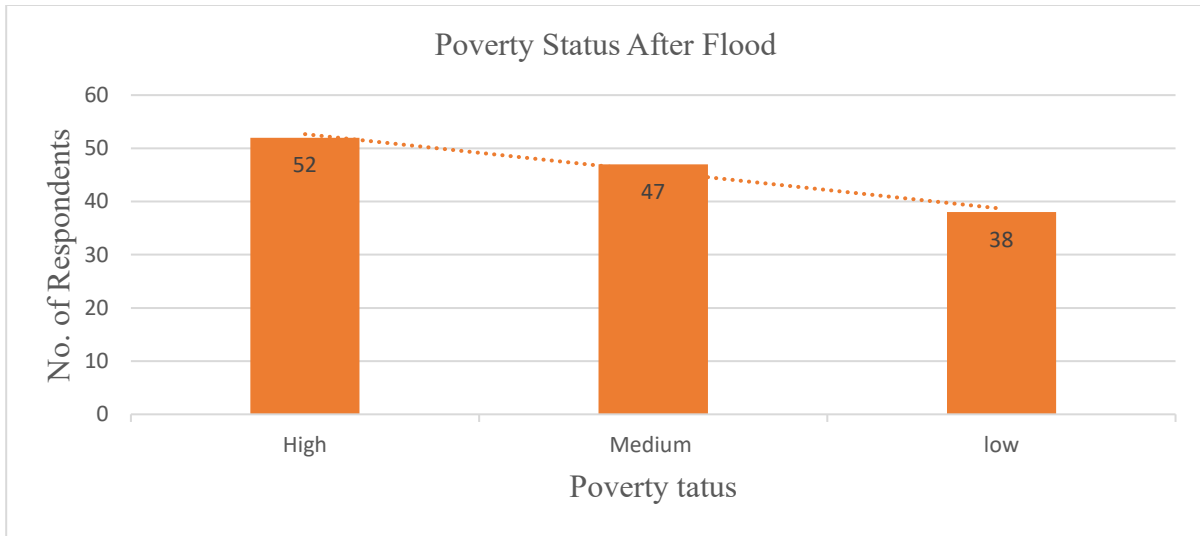


Figure 7: Poverty Status After Flood

4.1.6 Correlation Between MPI and Poverty Status

4.1.6.1 Before Flood

The Multidimensional Poverty Index (MPI) and poverty status have a weakly negative link, as indicated by the correlation measure of -0.19. This implies that poverty status tends to decline, albeit veritably slightly, as the MPI rises, indicating adding situations of multidimensional poverty. virtually, this can mean that regions or groups that witness increased situations of multidimensional poverty aren't inescapably seeing a rise in traditional measures of poverty, or vice-versa. While poverty status constantly refers to income- grounded criteria, the MPI is a comprehensive measure that takes into account a variety of losses in health, education, and living norms. The intricacy of poverty, where multifaceted causes don't inescapably line with income situations, may be stressed by the weak negative association (Alkire & Santos, 2010).

4.1.6.2 After Flood

A high correlation (0.99) shows that the MPI, which assesses poverty in a number of areas (similar as health, education, and living norms), nearly matches further conventional pointers of poor status, similar income- grounded evaluations. It implies that people or families classified as impoverished by the MPI are presumably also bankrupted by traditional measures of poverty.

The MPI can be used to condense or indeed replace income- grounded measures in order to gain a more complete picture of poverty, as seen by the near-perfect correlation, which shows

that the MPI is a reliable instrument for landing the overall poverty condition. This finding is significant because it highlights the need for further thorough evaluations in policy- timber and intervention enterprise and supports the utility of multidimensional poverty criteria in reflecting the realities of poverty beyond income alone (Alkire & Foster, 2011).

4.2 Discussion

4.2.1 Loss and Damage

The Multidimensional Poverty Index (MPI) was a comprehensive measure that assessed poverty by considering colorful factors beyond just fiscal income. It estimated losses in health, education, and living conditions to give a clearer picture of what it meant to be poor. For case, an MPI change of 0.03 indicated that only 3% of the population was classified as multidimensionally poor, suggesting a fairly low position of poverty when comparing the situation ahead and after the cataracts. This low chance inferred those utmost individualities in the assessed population enjoyed better living conditions and had access to essential services, which was a positive sign (Alkire & Jahan, 2018).

When looking at the MPI in the environment of flooding events, it came apparent how these disasters could impact communities. The bracket of individualities as multidimensionally poor meant they faced multiple losses contemporaneously, similar as poor health issues or lack of educational openings. Still, the fairly low MPI score suggested that numerous people had bettered their living conditions and access to necessary coffers over time. This enhancement reflected broader trends where communities worked towards reducing poverty by enhancing access to education, healthcare, and introductory living norms (Alkire et al., 2022). Overall, the MPI served as an important tool for understanding poverty in a further nuanced way, allowing for better- targeted interventions to support those most in need.

4.2.1.1 MPI of Malamchi Municipality with Provincial MPI

The Multidimensional Poverty Index (MPI) before the flood in Melamchi Municipality showed that Ward 6 (0.11) and Ward 10 (0.14) had MPIs higher than most provinces, excluding Madhesh (0.109), Karnali (0.169), and Sudurpaschim (0.106). Ward 11 (0.12) had an MPI close to Madhesh and Sudurpaschim but was lower than Karnali, indicating that these wards were already experiencing significant poverty levels, especially Ward 10, which had one of the highest MPIs pre-flood (CBS and OPHI, 2021).

After the flood, all observed wards in Melamchi experienced an increase in MPI, reflecting worsening poverty. Ward 6's MPI rose from 0.11 to 0.14, aligning it closely with Sudurpaschim Province (0.106), while Ward 10 increased from 0.14 to 0.15, surpassing the pre-flood MPI of all provinces except Karnali. Ward 11 experienced the most severe impact, with its MPI jumping from 0.12 to 0.27, which exceeded the MPI of all provinces, including Karnali (0.169). This stark increase suggested that Ward 11 underwent a dramatic deterioration in multidimensional poverty following the flood, highlighting the region's vulnerability to environmental disasters (UNDP, 2023). The sharp rise in MPI post-flood underlined the profound socio-economic effects that natural disasters could have on poverty in vulnerable regions like Melamchi. The substantial increase in Ward 11's MPI indicated that the flood exacerbated existing deprivations, leading to heightened poverty across multiple dimensions. This emphasized the need for targeted disaster recovery and poverty alleviation efforts in disaster-prone areas to mitigate the long-term impacts on communities (CBS and OPHI, 2021; UNDP, 2023).

4.2.2 Poverty Status

The substantial influence of natural disasters on multidimensional poverty was demonstrated by comparing the poverty levels in Melamchi Municipality before and after the flood. Prior to the flood, there were 40 households classified as being in the "High" poverty level, 39 in the "Medium," and 58 in the "Low" category. However, after the flood, the number of households in the "High" poverty category increased dramatically to 52, while those in the "Low" category decreased to just 38. This significant change reflected the devastating impact of the flood on household living conditions, which caused many families to fall into even greater poverty due to their inability to access essential infrastructure and resources.

Natural disasters tend to exacerbate existing vulnerabilities, as highlighted by Alkire and Foster (2011), necessitating comprehensive poverty alleviation measures that consider both economic and environmental aspects. The increase in households classified as "High" poverty following the flood illustrated how natural catastrophes could tighten poverty's grip on communities. The flood not only pushed more families into severe poverty but also intensified existing deprivations, leading to a greater overall level of multidimensional poverty. This situation

emphasized the urgent need for targeted disaster recovery efforts and poverty alleviation strategies in areas prone to such environmental challenges.

The findings echoed broader trends observed globally, where natural disasters have profound socio-economic effects on vulnerable populations. According to a World Bank report, natural disasters force approximately 26 million people into poverty each year and result in annual consumption losses of about \$520 billion (World Bank, 2016). These statistics highlight that poor communities often bear the brunt of such disasters due to their limited resources and resilience. Therefore, it became clear that effective disaster risk reduction strategies must be implemented alongside poverty alleviation efforts to mitigate long-term impacts on vulnerable communities (World Bank, 2016; GFDRR, 2022).

4.2.3 Correlation between MPI and Poverty Status

The increase in high levels of poverty following the flood is consistent with the idea of multidimensional poverty, which takes into account living standards, health, and education deficiencies in addition to money. In this instance, there is a weakly negative association (-0.19) between the Multidimensional Poverty Index (MPI) and poverty status, despite the fact that the MPI shows low overall poverty levels (0.03). This implies that traditional income-based measurements of poverty do not always rise in tandem with an increase in multidimensional poverty. The disparity between the two measures highlights the complexity of poverty, since a household's total deprivation is influenced by a variety of factors, including income (Alkire & Santos, 2010).

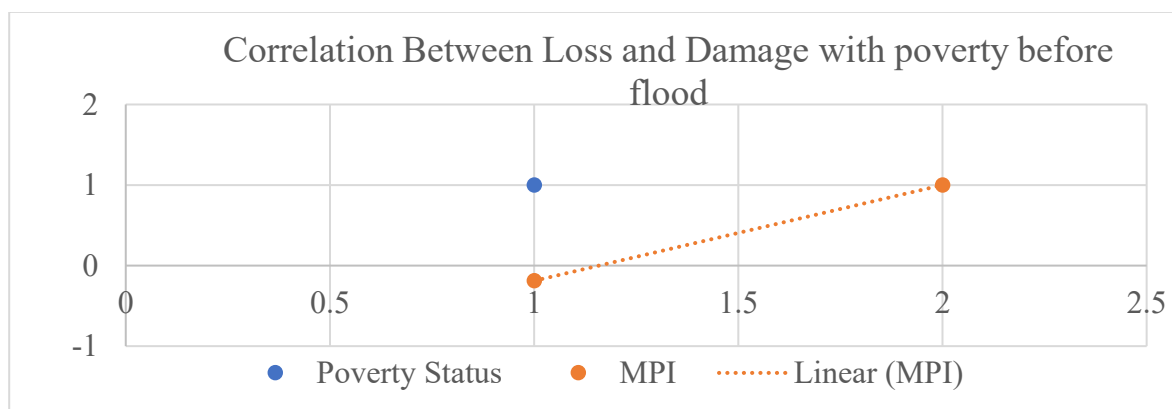


Figure 8: Correlation between loss and damage with poverty before flood

Additionally, the nearly perfect connection (0.99) between MPI and conventional measures of poverty emphasizes that, despite possible minor differences, households classified as impoverished by MPI are frequently also impoverished by income-based standards. This bolsters the claim that multifaceted metrics offer a more comprehensive understanding of poverty and can either supplement or even take the place of income-based evaluations for formulating policy. Effective poverty reduction initiatives depend on the MPI's capacity to capture a wider range of deprivations, particularly those made worse by disasters, given the notable changes in poverty levels following floods (UNDP, 2019).

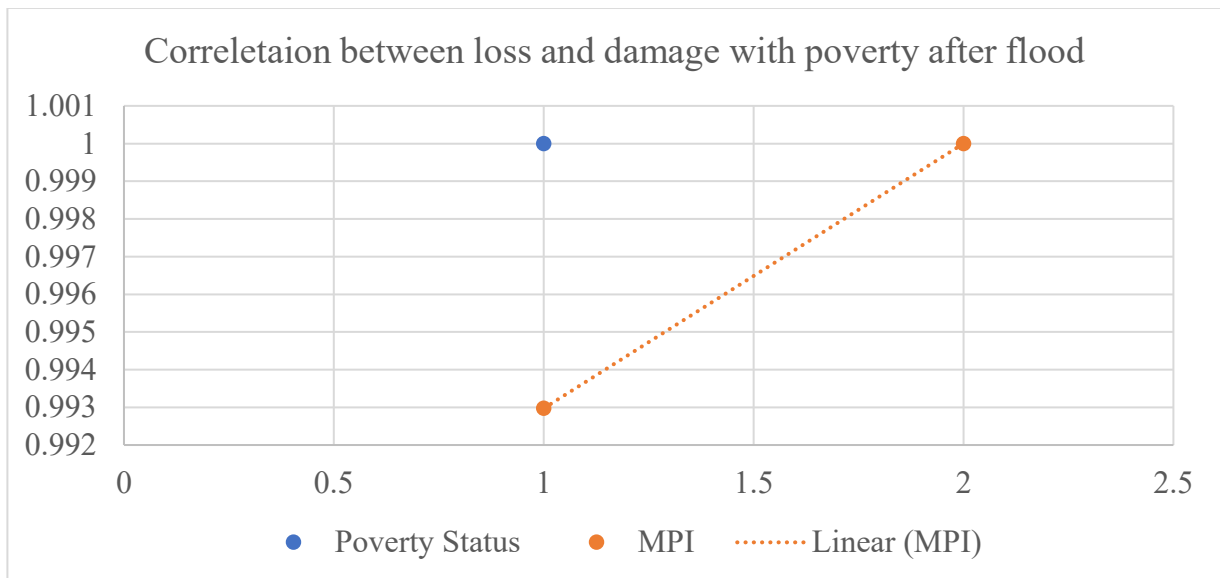


Figure 9: Correlation between loss and damage with poverty after flood

Given the Melamchi statistics, the post-disaster rise in poverty highlights how crucial resilience-building strategies are to reducing poverty. The devastation of livelihoods, resources, and infrastructure caused by natural catastrophes like floods frequently results in a dramatic rise in poverty in the affected communities. This highlights the necessity of interventions that confront the multifaceted character of deprivation in addition to income poverty, making sure that recovery initiatives concentrate on restoring living standards, health, and education in addition to financial assistance (Alkire & Foster, 2011).

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The analysis of poverty levels in Melamchi Municipality before and after the flood highlighted the profound impact that natural disasters can have on vulnerable communities. The significant increase in the number of households classified as experiencing "High" poverty after the flood underscored the devastating effects of such events on living conditions and access to essential resources. Many families faced heightened challenges as they struggled to recover from the immediate aftermath of the disaster. This situation illustrated how natural catastrophes exacerbate existing vulnerabilities, pushing individuals and families further into poverty and complicating their ability to meet basic needs. As noted by various studies, including those by Alkire and Foster (2011), it became clear that effective interventions must address both economic and environmental factors to mitigate the long-term impacts of such disasters (Béné et al., 2021).

Furthermore, the findings emphasized the necessity for targeted poverty alleviation strategies in disaster-prone areas like Melamchi. The dramatic changes in the Multidimensional Poverty Index (MPI) indicated that not only did more people fall into severe poverty, but those already struggling faced even greater hardships. This situation called for comprehensive recovery efforts that considered the unique challenges faced by different wards within the municipality. By prioritizing resources and implementing tailored strategies, local authorities could better support communities in rebuilding their lives and improving their socio-economic conditions. The evidence from this case study served as a reminder of the importance of integrating disaster risk reduction into poverty alleviation programs to foster resilience and enhance overall community well-being (Peters et al., 2023; Béné et al., 2021).

5.2 Recommendation

- Local, Provincial and Federal government should develop and implement tailored poverty alleviation programs that specifically address the unique needs of households classified as experiencing "High" poverty, especially in Ward No. 11 severely impacted

by the flood. These programs should focus on improving access to essential services such as healthcare, education, and housing.

- Incorporate disaster risk reduction measures into local governance and development plans to enhance community resilience. This includes assessing vulnerabilities to natural disasters and implementing infrastructure improvements that can mitigate the impact of future floods on vulnerable populations.
- Encourage policymakers to adopt the Multidimensional Poverty Index (MPI) as a key tool for understanding poverty dynamics. By integrating MPI assessments into decision-making processes, authorities can better identify the specific needs of different wards and allocate resources effectively to combat poverty while enhancing resilience against future disasters.

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APPENDICES

APPENDIX I: HOUSEHOLD SURVEY QUESTIONNAIRE

ASSESSMENT OF THE FLOOD INDUCED LOSS AND DAMAGE BY USING MULTI-DIMENSIONAL POVERTY INDEX IN MELAMCHI MUNICIPALITY SINDHUPALCHOWK, NEPAL

General Information

1. Name of Household Head:
2. Ward Number:
3. Village/Town:
4. Number of people in Household:
5. Main source of income for the household:

Multidimensional Poverty Index:

This questionnaire is designed to assess living standards, health, and education to identify potential multidimensional poverty.

Please answer all questions by selecting the option that best reflects your situation. Your responses are confidential and will be used for statistical purposes only.

I. Health (15 questions)

1. In the past month, have any household members been sick and unable to work or attend school for more than a week? (Yes/No)
2. How many household members have difficulty accessing basic healthcare services (clinics, hospitals)? (0, 1, 2, 3 or more)
3. Have any household members experienced a preventable illness in the past year (e.g., diarrhea, malaria)? (Yes/No)
4. Are all children under 5 in the household fully vaccinated according to the national immunization schedule? (Yes/No)

5. Do any household members have a chronic illness requiring regular medication?
(Yes/No)
6. If yes to question 5, can the household afford the necessary medication ALWAYS (1), SOMETIMES (2), or NEVER (3)?
7. Does the household have access to clean and SAFE drinking water (1 - Always safe, 2 - Sometimes safe, 3 - Never safe)?
8. Does the household have access to proper sanitation facilities (toilets, latrines)?
(Yes/No)
9. Is there sufficient food available for all household members THROUGHOUT THE YEAR (1 - Always, 2 - Most of the time, 3 - Sometimes, 4 - Rarely)?
10. Do any household members suffer from malnutrition (underweight, stunting)? (Yes/No)
11. Are pregnant women in the household receiving prenatal care from a qualified healthcare provider AT LEAST ONCE (1) or NOT AT ALL (2)?
12. Have any household members experienced violence or physical abuse in the past year?
(Yes/No)
13. Do any household members have a disability that limits their daily activities? (Yes/No)
14. If yes to question 13, does the household have access to support services for people with disabilities (1 - Yes, 2 - No)?
15. How satisfied are you with the overall health services available to your household? (1 - Very unsatisfied, 2 - Somewhat unsatisfied, 3 - Neither satisfied nor unsatisfied, 4 - Somewhat satisfied, 5 - Very satisfied)

II. Education (15 questions)

1. Are all children aged 6-14 in the household enrolled in primary school? (Yes/No)
2. If no to question 1, what is the MAIN REASON children are not attending school? (1 - Financial constraints, 2 - Lack of access, 3 - Cultural reasons, 4 - Other)
3. Do children in the household attend school REGULARLY (missing less than 20% of classes)? (Yes/No)
4. Are there any schools WITHIN WALKING DISTANCE (15 minutes) of your home?
(Yes/No)

5. Do schools in your community have ADEQUATE learning materials (textbooks, supplies) (1 - Yes, always, 2 - Sometimes, 3 - No)?
6. Do schools provide a SAFE AND SECURE learning environment for children? (Yes/No)
7. How satisfied are you with the overall quality of education in your community? (1 - Very unsatisfied, 2 - Somewhat unsatisfied, 3 - Neither satisfied nor unsatisfied, 4 - Somewhat satisfied, 5 - Very satisfied)
8. Do any adults in the household have BASIC literacy and numeracy skills? (Yes/No)
9. Are there any opportunities for adults in the household to receive FURTHER education or training (1 - Yes, 2 - No)?
10. How important do you consider education for improving household well-being? (1 - Very unimportant, 2 - Somewhat unimportant, 3 - Somewhat important, 4 - Important, 5 - Very important)
11. Does the cost of education prevent any household members from attending school or training programs? (Yes/No)
12. Are there any SCHOLARSHIPS or financial assistance programs available for education in your community (1 - Yes, 2 - No)?
13. Do cultural norms or traditions hinder GIRLS' education in your community? (Yes/No)
14. How satisfied are you with the overall educational opportunities available to your household? (1 - Very unsatisfied, 2 - Somewhat unsatisfied, 3 - Neither satisfied nor unsatisfied, 4 - Somewhat satisfied, 5 - Very satisfied)
15. Do you believe education is a key factor in ESCAPING POVERTY? (1 - Strongly disagree, 2 - Disagree, 3 - agree 4- strongly agree)

Living Standards (15 questions)

1. What is the main source of income for your household? (1 - Wage employment, 2 - Self-employment, 3 - Remittances, 4 - Government assistance, 5 - Other)
2. Is the income from your main source sufficient to meet your household's BASIC NEEDS (food, shelter, clothing) MOST OF THE TIME (1) or RARELY (2)?
3. Do you OWN (1) or RENT (2) the dwelling you live in?

4. If you rent, is the cost of rent MORE THAN HALF (1) or LESS THAN HALF (2) of your household's income?
5. Is your dwelling unit constructed with DURABLE materials (e.g., brick, concrete)? (Yes/No)
6. Does your dwelling have ENOUGH SPACE to accommodate all household members with AT LEAST 4 SQUARE METERS per person (1 - Yes, 2 - No)?
7. Does your dwelling have access to ELECTRICITY (Yes/No)
8. Does your dwelling have access to COOKING FACILITIES (stove, oven) (Yes/No)
9. Does your dwelling have access to BASIC SANITATION FACILITIES (toilet or latrine) WITHIN THE DWELLING (1) or OUTSIDE (2)?
10. Does your dwelling have access to CLEAN WATER (piped water, protected well) INSIDE THE DWELLING (1) or OUTSIDE (2)?
11. Do you have access to a SAFE and RELIABLE method of WASTE DISPOSAL (garbage collection, proper dumping site) (Yes/No)
12. Do you own any DURABLE ASSETS (furniture, appliances) (1 - Yes, some, 2 - No)?
13. How often are you able to AFFORD NEW CLOTHING for household members (1 - Every season, 2 - Once a year, 3 - Less than once a year)?
14. How often are you able to AFFORD MEAT, FISH, or POULTRY in your diet (1 - Every day, 2 - Several times a week, 3 - Less than several times a week)?
15. How satisfied are you with your overall STANDARD OF LIVING? (1 - Very unsatisfied, 2 - Somewhat unsatisfied, 3 - Neither satisfied nor unsatisfied, 4 - Somewhat satisfied, 5 - Very satisfied)

APPENDIX II: FOCUS GROUP DISCUSSION QUESTIONNAIRE

Introduction

- Briefly introduce the purpose of the focus group: to understand the community's needs and challenges.
- Assure participants that their responses are confidential.

Core Questions

- **Education**
 - How many years of formal education have you completed?
 - What are the main challenges faced in accessing education in your community?
 - What are your expectations for your children's education?
- **Health**
 - Have you or any member of your household been unable to afford necessary medical care in the past year?
 - What are the main health challenges faced by your community?
 - How accessible are healthcare facilities?
- **Standard of Living**
 - Do you have access to a safe and secure dwelling with proper sanitation facilities?
 - Do you have access to a reliable source of clean drinking water?
 - How often do you experience food insecurity in your household?
 - What are the main factors affecting your household's standard of living?
- **Employment**
 - Are you currently employed full-time, part-time, or unemployed?
 - If employed, do you feel your current income is sufficient to meet your basic needs?
 - What are the main employment challenges in your community?
- **Social Security**
 - Do you or any member of your household receive any form of social assistance?
 - If you receive social assistance, is it sufficient to meet your basic needs?
 - What kind of social support programs are needed in your community?
- **Social Participation**
 - Do you feel a sense of belonging and participation in your community activities?
 - What are the main challenges to community participation?
- **Children**
 - Do all children in your household attend school regularly?
 - How satisfied are you with the quality of education your children are receiving?
 - What are the main challenges faced by children in your community?

- **Assets**
 - Do you own any form of property or assets?
 - How important are assets in ensuring your family's well-being?
- **Shocks**
 - Has your household experienced any major shocks in the past year?
 - How did you cope with the shock?
 - What kind of support do you need to recover from shocks?
- **Vulnerability**
 - How worried are you about your ability to meet your basic needs in the future?
 - What are the main factors contributing to your vulnerability?

APPENDIX III: KEY INFORMANT INTERVIEW QUESTIONNAIRE

Thank you for agreeing to participate in this interview. We are conducting research on multidimensional poverty in loss and damage induced by flood using the Multidimensional Poverty Index (MPI). This interview aims to understand your perspective on the various aspects of poverty in this community.

Background (1-2 questions):

1. What is your role/position in the community? (e.g., Local leader, NGO representative, social worker)
2. For how long have you been working in this area?

Dimensions of Poverty (3 questions per dimension):

Health

1. In your opinion, what percentage of households in this community lack access to basic healthcare facilities? (0-100%)
2. How prevalent are chronic illnesses among residents here? (Very low, Low, Moderate, High, Very High)

3. Do you believe there are enough qualified healthcare professionals serving this community? (Yes, No, Unsure)

Education

4. What percentage of children in this area would you say are not enrolled in primary school? (0-100%)
5. How many years of education do most adults in this community have on average? (Less than 5 years, 5-10 years, more than 10 years)
6. Are there any major challenges hindering access to quality education in this area? (Yes, No, Unsure) (If yes, probe for details)

Living Standards

7. What percentage of households in this community would you consider living in inadequate housing conditions (overcrowded, unsafe structures)? (0-100%)
8. Do most households in this community have access to clean drinking water and sanitation facilities? (Yes, No, Unsure)
9. How often would you say families here experience food insecurity (difficulty affording enough food)? (Never, Rarely, Sometimes, Often, Very Often)

Work and Income

10. What is the main source of income for most families in this community? (Agriculture, Wage labor, Self-employment, Other)
11. In your experience, how prevalent is underemployment or unemployment in this area? (Very low, Low, Moderate, High, Very High)
12. Do you believe there are sufficient opportunities for people here to earn a decent living wage? (Yes, No, Unsure)

Social Protection and Inclusion

13. Are there any social safety nets or programs available to assist vulnerable families in this community? (Yes, No, Unsure) (If yes, probe for details on effectiveness)

14. How well-integrated are marginalized groups (e.g., disabled, elderly) into community life? (Very well, Well, Somewhat, not well, not at all)
15. Do you believe there are any forms of discrimination or social exclusion impacting certain groups here? (Yes, No, Unsure) (If yes, probe for details).

APPENDIX IV: LIST OF RESPONDENTS

LIST OF KEY INFORMANT INTERVIEW RESPONDENTS

| S.N. | Name of Respondents | Designation | Remarks |
|------|------------------------|---------------------|-----------------------|
| 1 | Sudhin Raj Budhathoki | Education Officer | Melamchi Municipality |
| 2 | Sujan Dulal | Environment Officer | Melamchi Municipality |
| 3 | Prem Bahadur Tamang | Ward Chairperson | Ward No. 6 |
| 4 | Amrit Khanal | Ward Chairperson | Ward No. 10 |
| 5 | Chandra Bahadur Tamang | Ward Chairperson | Ward No. 11 |

LIST OF FOCUS GROUP DISCUSSION RESPONDENTS

| S.N. | Name of Respondents | Designation | Remarks |
|------|---------------------|-------------|------------------------------------|
| 1 | Som Dulal | Chairperson | Municipal Level Disability Network |
| 2 | Balchandra Sapkota | Secretary | Fatte Community Forest |
| 3 | Aashman Tamang | Chairperson | CDMC |

LIST HOUSEHOLD SURVEY RESPONDENTS

| S.N. | Name of Respondents | Ward No. |
|------|-----------------------|----------|
| 1 | Som Bahadur Aryal | 6 |
| 2 | Nil Bahadur Thapa | 6 |
| 3 | Arjun Acharya | 6 |
| 4 | Krishna Bahadur Thapa | 6 |
| 5 | Durga Bhattarai | 6 |
| 6 | Hom Bahadur Chalise | 6 |
| 7 | Som Bahadur Aryal | 6 |
| 8 | Parbati Thapa | 6 |
| 9 | Om Bahadur Karki | 6 |
| 10 | Rajan Thapa | 6 |

| | | |
|----|------------------------|----|
| 11 | Janak Bahadur Karki | 6 |
| 12 | Yak Bahadur Karki | 6 |
| 13 | Lok Bahadur Thapa | 6 |
| 14 | Dandapani Chalise | 6 |
| 15 | Khok Bahadur Thapa | 6 |
| 16 | Chatra Bahadur Aryal | 6 |
| 17 | Jitraj Thapa | 6 |
| 18 | Tilak Bdr Thapa | 6 |
| 19 | Jagat Bdr Thapa | 6 |
| 20 | Bir Bdr Basnet | 6 |
| 21 | Sukuman Tamang | 6 |
| 22 | Ganesh Tamang | 6 |
| 23 | Lok Bahadur Tamang | 6 |
| 24 | Khola Prasad Dhungana | 6 |
| 25 | Bashu Dhungana | 6 |
| 26 | Goma Deuja | 6 |
| 27 | Min Bahadur Deuja | 6 |
| 28 | Aaita Tamang | 6 |
| 29 | Kanchhi Tamang | 6 |
| 30 | Dev Thapa Magar | 6 |
| 31 | Min Kumari Thapa Magar | 6 |
| 32 | Balsundar Thapa | 6 |
| 33 | Ramesh Dhungana | 6 |
| 34 | Kabita Giri | 6 |
| 35 | Krishna Giri | 6 |
| 36 | Bhim Bahadur Sunar | 6 |
| 37 | Hari Prasad Acharya | 6 |
| 38 | Lila Kumari Basnet | 6 |
| 39 | Dhan Bahadur Basnet | 6 |
| 40 | Mithu Basnet | 10 |

| | | |
|----|------------------------|----|
| 41 | Dirga Kumari Karki | 10 |
| 42 | Rajan Karki | 10 |
| 43 | Lila Dulal | 10 |
| 44 | Udhan Aale | 10 |
| 45 | Prem Bahadur Chapagain | 10 |
| 46 | Rudra Bdr Chapagain | 10 |
| 47 | Krishna Bdr BK | 10 |
| 48 | Jit Bdr BK | 10 |
| 49 | Binod Tamang | 10 |
| 50 | Rupak Chauhan | 10 |
| 51 | Buddha Gambhir Tamang | 10 |
| 52 | Sanu Indra Bdr Tamang | 10 |
| 53 | Dipendra Karki | 10 |
| 54 | Krishna Bahadur Khadka | 10 |
| 55 | Parbati Adhikari | 10 |
| 56 | Maya Tamang | 10 |
| 57 | Tika Devi Sapkota | 10 |
| 58 | Yadu Bahadur Basnet | 10 |
| 59 | Prakash Basnet | 10 |
| 60 | Govinda Basnet | 10 |
| 61 | Lali Magar | 10 |
| 62 | Yaba Singa | 10 |
| 63 | Kul Prasad Chalise | 10 |
| 64 | Purna Bahadur Tamang | 10 |
| 65 | Sharmila Thapa | 10 |
| 66 | Hari Kandel | 10 |
| 67 | Dip Mijar | 10 |
| 68 | Samjhana Sapkota | 10 |
| 69 | Junkiri Tamang | 10 |
| 70 | Kamala Tamang | 10 |

| | | |
|-----|-------------------------|----|
| 71 | Bhim Bahadur Nepali | 10 |
| 72 | Hem Kumari Magar | 11 |
| 73 | Madan Shrestha | 11 |
| 74 | Chandralal Shrestha | 11 |
| 75 | Sambhu Prasad Chaulagai | 11 |
| 76 | Dasrath Danuwar | 11 |
| 77 | Bhaba Prasad Dulal | 11 |
| 78 | Prem Narayan Lamichhane | 11 |
| 79 | Buddhi Tamang | 11 |
| 80 | Ishwori Dulal | 11 |
| 81 | Dil Bdr Pariyar | 11 |
| 82 | Ujeli Karki | 11 |
| 83 | Bhim Prasad Dangal | 11 |
| 84 | Sumitra Dulal | 11 |
| 85 | Prakash Dahal | 11 |
| 86 | Shyam Mani Chalise | 11 |
| 87 | Jaykrishna Shrestha | 11 |
| 88 | Junu Maya Tamang | 11 |
| 89 | Kanxa Rai | 11 |
| 90 | Delnath Dulal | 11 |
| 91 | Yagya Prasad Dahal | 11 |
| 92 | Ganga Shrestha | 11 |
| 93 | Bishworam Khadka | 11 |
| 94 | Sarki Danuwar | 11 |
| 95 | Dom Prasad Dulal | 11 |
| 96 | Prem Krishna Shrestha | 11 |
| 97 | Yog Prasad Dulal | 11 |
| 98 | Yagya Bahadur Chalise | 11 |
| 99 | Mamata Thapa | 11 |
| 100 | Gokul Khadka | 11 |

| | | |
|-----|-----------------------|----|
| 101 | Ambika Khadka | 11 |
| 102 | Kumar Majhi | 11 |
| 103 | Chitra Bahadur Tamang | 11 |
| 104 | Dil Bahadur Majhi | 11 |
| 105 | Tirtha Tamang | 11 |
| 106 | Krishna Prasad Dulal | 11 |
| 107 | Bishnu Prasad Gautam | 11 |
| 108 | Sushila Khadka | 11 |
| 109 | Bimala Baniya | 11 |
| 110 | Keshav Pandey | 11 |
| 111 | Yubraj Magar | 11 |
| 112 | Suresh Ghorasaini | 11 |
| 113 | Goma Danuwar | 11 |
| 114 | Bhim Bahadur Danuwar | 11 |
| 115 | Parbati Danuwar | 11 |
| 116 | Sanu Danuwar | 11 |
| 117 | Ganesh Puri | 11 |
| 118 | Minu Gurung | 11 |
| 119 | Bal Kumari Gurung | 11 |
| 120 | Ramkumar Shrestha | 11 |
| 121 | Sraman Shrestha | 11 |
| 122 | Aartan Shrestha | 11 |
| 123 | Naina Bahadur Chalise | 11 |
| 124 | Laxmi Dulal | 11 |
| 125 | Som Tamang | 11 |
| 126 | Maita Singh Tamang | 11 |
| 127 | Som Bahadur Ghale | 11 |
| 128 | Hiramani Chalise | 11 |
| 129 | Dol Bahadur Ghale | 11 |
| 130 | Bharat Parajuli | 11 |

| | | |
|-----|-------------------------|----|
| 131 | Suku Laxmi Tamang | 11 |
| 132 | Dil Bahadur Tamang | 11 |
| 133 | Komal Payari Shrestha | 11 |
| 134 | Jagat Bahadur Shrestha | 11 |
| 135 | Sasi Lochan Dhital | 11 |
| 136 | Keranath Sapkota | 11 |
| 137 | Ishori Prasad Bhattarai | 11 |

APPENDIX V: CORRELATION BETWEEN POVERTY STATUS AND MPI

BEFORE FLOOD


| S.N. | Poverty Status | MPI | Correlation(r) |
|------|----------------|------|----------------|
| 1 | 10 | 0.11 | -0.18898 |
| 2 | 10 | 0.14 | |
| 3 | 20 | 0.12 | |

AFTER FLOOD

| S.N. | Poverty Status | MPI | Correlation(r) |
|------|----------------|------|----------------|
| 1 | 12 | 0.14 | 0.99297 |
| 2 | 11 | 0.15 | |
| 3 | 29 | 0.27 | |

APPENDIX VI: OFFICIAL LETTERS

Letter From Melamchi Municipality for the collection of data



SchEMS
School of Environmental
Science and Management
Affiliated to Pokhara University
०९|२०८१|०८२

Kritimarg, Kateshwar-32,
PO BOX : 14195, Kathmandu, Nepal
Tel: 01-5911892 | 9749405825
Email: mail@schems.edu.np
http://www.schems.edu.np

2024/08/09

मेलम्ची नगरपालिका
सिन्धुपाल्चोक
संस्था नं. २०८१/०८२

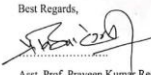
To,
Sudhir Raj, Budhanthoki
Melamchi Municipality
Municipality Office

Sub: To provide the necessary data and help for academic research(Thesis)


This is to certify that Mr. Dharma Raj Sorali is a M.Sc. Student at School of Environmental Science and Management, SchEMS affiliated to Pokhara University, Nepal. I believe Mr.Sorali to be a sincere and intelligent student. With his exemplary research skills and tremendous character, Mr. Sorali has been observed as a diligent student during his stay at SchEMS.

Mr.Sorali is an active student with a very inquisitive mind and has the ability to engage in numerous challenging tasks without compromising his work quality. Furthermore, his hard work and creativity has enhanced his technical skills in the area of his interest.

He is doing research regarding loss and damage by using poverty index in Melamchi for 15 days. For his entire research, he needs some help, data and information from your esteemed organization. So, kindly request you and your organization to help his in gathering data and information required for his research work (Thesis). Thank you for your cooperation!

Best Regards,

Asst. Prof. Praveen Kumar Regmi
Coordinator/Faculty Member
M.Sc. Environmental Science and Management


*श्री धर्म
सोरा
सिन्धुपाल्चोक
२०८१/०८२*



मेलम्ची नगरपालिका
नगर कार्यपालिकाको कार्यालय

मेलम्ची, सिन्धुपाल्चोक
बागमती प्रदेश, नेपाल

पत्र संख्या: २०८१/०८२
चलानी नं.: ४४८

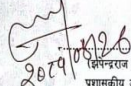


मिति: २०८१/०८/२७

विषय: आवश्यक सहयोग गरिदिने सम्बन्धमा ।

श्री बडा कार्यालय (बडा नं. ६, १० र ११)
मेलम्ची, सिन्धुपाल्चोक ।

प्रस्तुत विषयमा School of Environmental Science and Management (SchEMS), काठमाडौंमा स्नातकोत्तर अन्तिम वर्षमा अध्ययनरत विद्यार्थी श्री धर्म राज सोरालीले मेलम्ची नगरपालिकाको बडा नं. ६, १० र ११ मा विवरबाट भएको हानि नोक्सानी विषयमा अनुसन्धान गर्नका लागि निवेदन पत्रा गरेकोमा उक्त अनुसन्धानका लागि आवश्यक विवरण एवं तथ्यांक उपलब्ध गराई सहयोग गरिदिनुहुन अनुरोध गरिन्छ ।


२०८१/०८/२७
सिन्धुपाल्चोक
प्रशासकीय अधिकृत

"मेलम्ची नगर समृद्धिको आधार: कृषि, पर्यटन, उद्योग र जलाधार"

Contact: +977-01-401089, 011-401141, 011-401142 E-mail: info@melamchimn.gov.np Website: www.melamchimn.gov.np

Letter From Ward No. 11



SchEMS
School of Environmental
Science and Management
Affiliated to Pokhara University
०९|२०८१|०८२

Kritimarg, Kateshwar-32,
PO BOX : 14195, Kathmandu, Nepal
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Email: mail@schems.edu.np
http://www.schems.edu.np

2024/08/09

२०८१/०८/२७

To,
Chandra, Bdr. Tamang
Melamchi Municipality
Ward No. 11

Sub: To provide the necessary data and help for academic research(Thesis)

This is to certify that Mr. Dharma Raj Sorali is a M.Sc. Student at School of Environmental Science and Management, SchEMS affiliated to Pokhara University, Nepal. I believe Mr.Sorali to be a sincere and intelligent student. With his exemplary research skills and tremendous character, Mr. Sorali has been observed as a diligent student during his stay at SchEMS.

Mr.Sorali is an active student with a very inquisitive mind and has the ability to engage in numerous challenging tasks without compromising his work quality. Furthermore, his hard work and creativity has enhanced his technical skills in the area of his interest.

He is doing research regarding loss and damage by using poverty index in Melamchi for 15 days. For his entire research, he needs some help, data and information from your esteemed organization. So, kindly request you and your organization to help his in gathering data and information required for his research work (Thesis). Thank you for your cooperation!

Best Regards,

Asst. Prof. Praveen Kumar Regmi
Coordinator/Faculty Member
M.Sc. Environmental Science and Management

*श्री धर्म
सोरा
सिन्धुपाल्चोक
२०८१/०८/२७*

APPENDIX 1: PHOTOGRAPHS



Way to Melamchi Municipality



KII with Education Officer



FGD in Ward 6 with Fatte Community Forest



Household Survey in Ward No. 6

Way to Talarang





Household Survey in Ward No.10



Household Survey in Ward No. 11