CLIMATE CHANGE, DISASTERS & DEVELOPMENT NEXUS IN NEPAL

Unveiling Dynamics, Assessing Capacities and Advancing Resilience

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UMN

Digni

normisjon

Research team
Kabin Maharjan, Research and Learning Advisor, UMN. (Principal investigator)
Niki Maskey, Resilient Livelihoods Thematic Lead, UMN.
Sita Bantha Magar, CLIMATES Project Manager, Bajhang, UMN
Laxmi Kumari Awasthi, CLIMATES Project Manager, Doti, UMN
Suraj Sonar, DRR Focal Person, Rukum East, UMN
Dhanej Thapa, Climate and DRR Expert, External
Nabin Shrestha, DRR Expert, External

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Digni and Normisjon

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Communications Team, UMN

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FOREWORD

We are very happy to present this research report of a study conducted by the United Mission to Nepal (UMN) on the intricate interplay between climate change, disasters, and development in Nepal. The credit goes to Kabin Maharjan for leading the study. Congratulations! It is a great piece of work reflecting UMN's commitment to addressing the root causes of poverty and working towards the fullness of life for all in a transformed Nepali society. UMN recognises the significant impact of environmental hazards, including climate change, on vulnerable communities.

Though rich in biodiversity and natural resources, there is no denying that Nepal is particularly susceptible to the adverse effects of climate change and environmental degradation. The Poorest people are most vulnerable to their depletion or degradation, for they most directly depend on these natural resources. Thus, UMN acknowledges the need to mitigate the risks faced by these vulnerable populations and strives towards helping communities to live within and nurture a healthy and resilient environment, ensuring resources are used fairly in the present and are maintained for the future.

The research findings reveal the escalating climate and disaster risks in Nepal, characterised by unpredictable rainfall patterns, intense precipitation events, temperature fluctuations, declining winter rains, and droughts. Human activities have played a significant role in exacerbating these hazards, and the movement of people to hazard-prone areas has further increased their exposure to risks. The study also highlights the need to bridge the gaps and implement effective plans and strategies for local governments in dealing with climate and disaster risks. It emphasises the need to adopt climate-friendly technologies, leverage local innovations, and promote community-driven approaches, through which vulnerable communities can overcome resource constraints and enhance their resilience in the face of disaster risks. These low-cost strategies not only help curtail disaster risks but also strengthen the overall well-being and sustainable development of communities.

The report underscores the complex dynamics and interrelationships between climate change, disasters, and development, prompting fundamental questions about the transformation of development initiatives into disasters, the origins and developmental processes of disasters, and the role of human agency in their occurrence. While further research is necessary to provide comprehensive answers, the report emphasises the potential of community-based initiatives in mitigating the consequences of climate change and disasters.

The research report serves as a valuable resource for policymakers, practitioners, and stakeholders involved in addressing climate change and disaster risks in Nepal. UMN hopes that the insights and recommendations presented will contribute to informed decision-making, foster collaboration, and promote effective strategies for building resilience and sustainable development in the face of climate change and disasters.

Dhana Lama
Executive Director
United Mission to Nepal (UMN)

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We would like to express our gratitude to the following individuals and organisations for their invaluable support in successfully completing this research project.

Firstly, we would like to extend our thanks to Mr Ram Nath Ojha, Disaster Management Manager, UMN, for his expert insights and guidance in providing a peer review of the research report. We are also thankful to the communications team of UMN for their review and layout designs of the report.

We are also deeply grateful to Normisjon and Digni for their financial support, which has enabled us to conduct this research and gain valuable insights into the study of urgent issues, climate and disaster risks in Nepal.

We extend our heartfelt appreciation to UMN's Bajhang and Doti Cluster for their invaluable assistance in the data collection and monitoring process, which has contributed significantly to the success of this study. Special thanks to the local implementing partner of UMN - Dalit Help Society (DHS), Bajhang and The Rural Community Development Centre (RCDC), Doti, for their exceptional support in the data collection process without which this research would not have been possible.

Our heartfelt thanks go to Mr Dibesh Shrestha for supporting climate data analysis and to Ms Prerana Chand for supporting the data collection process which has been an invaluable asset to this study.

Finally, we would like to extend our sincere appreciation to all the research participants for their valuable information, which played a critical role in the success of this research project.

Once again, we express our deepest gratitude to all those who have contributed to this study in various ways and their assistance has been invaluable in shaping the final outcome.

Kabin Maharjan
Research Team Leader and Principal Investigator
June 2023

EXECUTIVE SUMMARY

This research report delves into the intricate interplay between climate change, disasters, and development, shedding light on the complex dynamics and significant impacts that emerge from their interactions in the context of Nepal, a country highly vulnerable to natural hazards. The study aims to understand the factors contributing to environmental degradation and natural disasters, assess the policy and institutional capacity at the local level, and identify climate-friendly technologies and solutions that are suitable for the local context.

This study conducted in Nepal's Doti and Bajhang Districts used qualitative techniques like interviews, focus groups, observation, and quantitative analysis of climate and disaster data. It employed a multi-method approach to identify hazards, risks, and adaptation strategies, incorporating participatory tools to capture diverse perspectives. The study also analysed policy gaps and identified climate-friendly technologies through action research for local development planning on climate change adaptation and disaster risk reduction.

The findings highlight that the escalating prevalence of both climatic and non-climatic hazards has contributed to the rise of climate and disaster risks, resulting in a wide array of adverse effects experienced by communities. Unpredictable rainfall patterns, intense precipitation events, fluctuations in maximum and minimum temperatures, declining winter rains, and recurrent droughts have left communities and their livelihoods under immense pressure. Human activities have played a crucial role in exacerbating these hazards, intensifying their impact on vulnerable regions. Concurrently, the migration of populations to hazard-prone areas has increased the exposure of individuals, agricultural practices, livelihoods, and human assets to elevated risks. The situation is further compounded by inadequate local government policies and governance, leading to unplanned and vulnerable settlements. Often, individuals migrate from safer locations to more hazardous areas in pursuit of improved facilities, services, and access. Furthermore, the construction of schools and public infrastructure in hazard-prone areas amplifies the exposure and sensitivity to natural disasters. Aquatic life damage and depletion of resources like fish and spring water also affect community livelihoods.

At the policy and institutional level, the study employs the UNDRR disaster resilient preliminary assessment scorecard to assess the resilience frameworks of two municipalities, highlighting areas of progress and improvement. The study reveals the limited ability of local governments to effectively address climate and disaster risks. This highlights a significant gap in the local government's capacity to attain disaster resilience and climate adaptation. Consequently, a comprehensive assessment of hazard, exposure, vulnerability, and capacity reveals the continuous and high-probability nature of disaster risk in affected communities. While both municipalities have made progress in certain areas, they lag behind others on their path to becoming disaster resilient multiplicities. It is crucial for them to address these gaps and implement the necessary plans and strategies to achieve resilience.

The report also emphasises the importance of climate-friendly technologies and local adaptive actions in building resilience and reducing disaster risks. Locally available seeds, solar cooking stoves, low-cost recharge pits, and resilient crop varieties are identified as viable solutions. However, support from government institutions, development organisations, and civil society groups is crucial to promote and sustain these initiatives.

The discussion section highlights the role of human activities in exacerbating natural hazards and converting them into disasters. It emphasises the need for incorporating disaster risk reduction measures into infrastructure and curriculums to minimise vulnerability. The integration of DRR and adaptation approaches into development policies and programs is necessary to achieve disaster resilience.

In conclusion, the study reveals the escalating risks associated with climate change and disasters, driven by both natural hazards and human factors. It highlights the vulnerability of communities and the limitations of local governments in addressing these risks, necessitating comprehensive strategies for disaster resilience and climate adaptation. The report raises critical questions about the transformation of development initiatives into disasters, and the role of human agencies in intensifying, calling for further research and proactive measures to address these challenges. It also argues that comprehending the 'hazard' in a given region is inadequate without acknowledging human activities or elements within its framework. Study acknowledging the potential of community-based initiatives and low-cost climate-friendly technologies to mitigate risks and promote resilience. By embracing these approaches, communities can overcome resource limitations and enhance their ability to withstand the challenges posed by climate change and disasters, ultimately ensuring sustainable development.

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ACRONYMS AND ABBREVIATIONS

Approx.	Approximately
Av.	Average
CCA	Climate Change Adaptation
CLIMATES	Climate Change Impacts Mitigation & Adaptation for Environmental Sustainability
DHS	Dalit Help Society
DPRP	Disaster Preparedness and Response Plan
DRR	Disaster Risk Reduction
DRRM	Disaster Risk Reduction and Management
FAO	Food and Agriculture Organisation
FGD	Focus Group Discussions
Ft^2	Square Feet
GDP	Gross domestic product
GIZ	The Deutsche Gesellschaft für Internationale Zusammenarbeit
HEOC	Health Emergency Operation Center
IFRC	International Federation of Red Cross and Red Crescent Societies
IPCC	The Intergovernmental Panel on Climate Change
KII	Key Informant Interviews
LAPA	Local Adaptation Plan of Action
LDCRP	Local Disaster and Climate Resilience Plan
LDCRP	Local Disaster Climate Resilient Plan
LDMC	The Local Disaster Management Committee
MoHA	Ministry of Home Affairs
MW	Megawatt
NA	Data not available
NAP	National Adaptation Plan
NAPA	National Adaptation Programme of Action
NDRRMA	National Disaster Risk Reduction and Management Authority
NEOC	National Emergency Operation Center
NPC	National Planning Commission
PVT	Participatory Varietal Trials
RCDC	The Rural Community Development Centre
RM	Rural municipality
SDG	Sustainable Development Goals
SPI	Standardised Precipitation Index
UMN	United Mission to Nepal
UN	United Nations
UNDP	United Nations Development Programme
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNESCO	The United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	The United Nations International Children's Emergency Fund

1

INTRODUCTION

1.1 Climate Change and Disaster

Climate change can exacerbate disaster risk in multiple ways, such as altering the frequency and intensity of hazardous events, magnifying vulnerability to hazards, altering exposure patterns, and reducing the resilience of households and communities. Empirical evidence indicates that climatic causes like erratic rainfall patterns associated with climate change have increased landslides, floods, and drought events. Conversely, research conducted by Vij et al. (2020) and Wanner (2022) has suggested that non-climatic reasons, such as socio-political context and human actions, have significantly escalated such extreme events, leading to disasters. This complex interplay of human actions and outcomes, along with natural phenomena, indicates that the causes of disasters stem from multiple factors.

1.2 Development and Disaster Interface

The outcome of the relationship between development and disasters can lead to positive prospects or negative setbacks, as pointed out by Manyena (2012). On the one hand, the development initiatives that address the underlying drivers of vulnerability, such as poverty, inequality, and environmental degradation, can reduce disaster risk. However, on the other hand, unplanned and mismanaged initiatives can result in crises and catastrophes. The UN platforms and other scientific bodies like UNDRR (2019) and IPCC (2014) have stressed that natural events do not solely cause natural disasters but are also the result of human malpractices. Cui et al. (2019) argue that in the Freetown disaster in Sierra Leone, 'rainfall was the trigger' for the disaster, but 'rapid and haphazard urban expansion was the catalyst'. There are numerous examples of how development efforts in developing countries, such as the overexploitation of natural resources, unplanned land

use changes, ad hoc application of new technologies in agriculture, and haphazard modernisation of the construction and transportation sectors, have had significant negative impacts, thus increasing overall climate change vulnerabilities (UNDP, 2020; Dar et al. 2022)

Inadequate regulation, governance, and corruption can equally contribute to creating man-made hazards. According to the research 'Political Economy of 2020 Landslides' published by Oxford Policy Management, the 'politics and power shape development interventions' creates a condition for disaster risks (Dixit et al., 2021). The article argues that the factors causing disasters go beyond natural reasons and extend to the political and economic contexts. Thus, hazards can be linked to hydro-meteorological conditions but are equally the outcome of unhealthy powerplay in the form of haphazard land use changes and unplanned development interventions. Vested interests and poor choices in development planning can lead to adverse consequences for both the environment and people. However, if development planning is undertaken rationally and cautiously, with mainstreaming disaster risk reductions, the initiatives can become an opportunity rather than a detriment.

1.3 Integrating Climate Change Adaptation, DRR and Development Planning

There is growing concern regarding integrating Climate Change Adaptation (CCA) and Disaster Risk Reduction (DRR). This is primarily because climate-induced hazards and disasters are becoming more frequent and challenging to disentangle while planning for risk-informed and climate-smart development (UNDP, 2020). Studies by Collins (2018) have reported an increase in such concerns and debates.

Although pathways have been envisioned and implemented at the national level in Nepal through the Sustainable Development Goals (SDG's), National Adaptation Plan, and the Disaster Risk Reduction National Strategic Plan of Action 2018-2030 to improve synergy and coherence between DRR and CCA, there is still a lack of integration with the development planning. The Government of Nepal has emphasised mainstreaming DRR and CCA into the development process of local governments through the Local Disaster and Climate Resilience Plan (LDCRP); however, allocation of budget is not mandatory. Likewise, there is also a poor understanding of how CCA and DRR can be integrated and mainstreamed into the overall local development planning.

Several studies have emphasised the need to incorporate climate change considerations in development planning to reduce disaster risks. For instance, Hallegatte et al. (2016) highlight the importance of integrating climate change and disaster risk management into development planning to enhance adaptive capacity, reduce vulnerability, and increase the resilience of communities. Similarly, (Pandey, Prakash, & Werners, 2021) underscores the need for a climate-resilient development approach that considers communities' specific climate risks and vulnerabilities. Integrating climate change considerations into development planning, policies, and programmes, can reduce disaster risks and enhance resilience. Other studies have explored the specific impacts of climate change on disaster risk in different regions and sectors. For instance, Birkmann et al. (2013) have examined the link between climate change and disaster risk in urban areas, highlighting the need for integrated approaches to urban planning and disaster risk reduction. Similarly, Thornton et al. (2011) have explored the impacts of climate change on food security and disaster risk in sub-Saharan Africa's agricultural

sector. The study stresses the importance of incorporating climate change considerations into agricultural development planning to reduce vulnerability to disasters and ensure food security.

Overall, the scientific literature emphasises the need to adopt a climate-resilient development approach that integrates climate change and disaster risk considerations into development planning. This approach can aid in increasing resilience, reducing vulnerability, and strengthening the adaptive capacity of communities in the face of climate change and disaster risks.

1.4 Nepalese Context

Nepal ranks 16th globally in terms of the most multi-hazard-prone countries in the world and 4th, 11th and 30th in terms of climate change, earthquake, and flood risk, respectively. According to the National Disaster Risk Reduction and Management Authority (NDRRMA), 75 percent of Nepal's land is susceptible to multiple hazards, with more than 80 percent of the population residing in high-risk areas (UNDRR, 2019). These risks are projected to escalate in the future due to the impacts of climate change, with agriculture, water-induced hazards, and hydroelectricity already imposing a substantial cost on the national GDP (IDS Nepal, PAC and GCAP, 2014). However, Nepal's unpreparedness for the intense disasters arising from climate change and unscrupulous development activities has been highlighted by several studies. This vulnerability is further amplified by factors such as acute poverty, inequality, poor adaptive capacity, high natural resource dependency and weak institutional capacity of Nepalese communities.

Agriculture is a critical sector for Nepal, supporting the livelihoods of more than 65.5 percent of the population and contributing significantly to the national gross domestic product. However, this sector is particularly vulnerable to water-induced hazards, which are becoming more frequent due to the changing climate conditions. The Intergovernmental Panel on Climate Change (IPCC) notes that agriculture is typically well-adapted to mean or average conditions but susceptible to irregular or extreme conditions, rendering it challenging for farmers to adapt (IPCC, 2014). Similarly, the problem of water scarcity is also becoming increasingly acute in many areas of the country due to the rapid drying up of natural springs and streams fed by seasonal rainfall (Sharma 2016). Several factors contribute to water scarcity in Nepal, including climate change-induced variability in rainfall and erratic weather patterns, overexploitation of groundwater resources, and inadequate management of water resources. While climate change impact is evident, various efforts and innovative practices are adopted and initiated at a local level, which is less documented and brought under scientific studies to tackle shocks and stresses at a local level. Robust and locally efficient climate-friendly technologies can be upscaled and mainstreamed.

Despite Nepal's four decades of efforts to address disaster risks through formal policies since 1982, the country still faces challenges in establishing a robust governance system for disaster risk reduction and translating those policies and guidelines into action. Additionally, in the new federal structure, The Local Governance Operations Act of 2017 has shifted the responsibility for disaster risk reduction and management to the municipalities, enabling significant decentralisation for decision-making, resource management, and service delivery systems. The Disaster Risk Reduction and Management (DRRM) Act 2015 and the National Disaster Risk Reduction Strategic Action Plan, 2018-2030 mandate that every local government prepares its local DRRM Laws and action plans. However, low

capacity and unfamiliarity with disaster management approaches and principles, particularly in municipalities, may impede local governments' ability to prepare for, reduce risks and respond to disaster events. Consequently, disaster initiation often occurs reactively following a major disaster or only in post-disaster phases. There is equally less community engagement, involvement, and ownership in disaster management efforts, a further challenge in achieving effective results. Nevertheless, the National Planning Commission (NPC) of Nepal recognises the need to integrate DRR into development planning processes and policy frameworks, requiring enhanced institutional capacity, better coordination among stakeholders, and increased investment in DRR.

Under these circumstances, the present study aims to investigate the factors contributing to environmental degradation and natural disasters, specifically focusing on assessing the impacts of climate change and human activities. Additionally, this study aims to evaluate the disaster resilience capacity of local governments. The focus is also on exploring some low-cost and locally viable climate-friendly technologies that can enhance the resilience of local communities. An attempt is also made to examine how local communities and municipalities understand and respond to climate change and disasters and whether their efforts are effectively linked with climate change impacts and associated disaster risks while achieving broader development planning aspects. Thus, the study hopes to better understand how local communities and municipalities can build resilience and minimise the effects of both climatic and non-climatic disasters. The study has been tied with a community development project, 'Climate-change Impacts Mitigation & Adaptation for Environmental Sustainability - (CLIMATES)', in pursuit of these objectives.

1.5 Linkages to the "CLIMATES" Project

United Mission to Nepal (UMN) is implementing a Climate-change Impacts Mitigation & Adaptation for Environmental Sustainability - (CLIMATES) project in the Doti and Bajhang Districts of Nepal, intending to enhance the resilience of communities to climatic 'shocks and stresses' through improving adaptation and mitigating practices. Generally, it is uncommon for development intervention projects to be accompanied by rigorous research that could inform effective implementation strategies and knowledge. Therefore, this study is linked to the CLIMATES project and broadly aims to serve as a foundation and strategic document that offers systematic knowledge, insight, and learning to design better activities, approaches, and project tactics. Linking research with project practice is an innovative approach that will contribute to achieving the CLIMATES project goals through synergy initiatives.

This study aims to investigate three research questions to contribute to the project's outcomes. The first research question, which explores the interplay between climates and disaster risk and human-induced environmental degradation, including poor natural resource management, will significantly contribute to project outcome one, which seeks to protect, conserve, and restore natural resources sustainably. The second research question, which examines the local government's policy, capacity, and resources in building a resilient community, will contribute to the project's third outcome, where the project aims to strengthen and facilitate the effective functioning of duty bearers, especially Ward/Rural Municipality (RM) and DRR committees, for better adaptation and mitigation of climatic and non-climatic hazards. The third action-research question, which involves experimenting with viable and appropriate

climate-friendly technologies in the project areas, aims to contribute to the project's second outcome, which seeks to develop adaptive capacities for climate shocks and stresses. It also seeks to contribute to the project's interest in promoting both indigenous and science-driven improved agricultural practices.

1.6 Objective of the Study

The first research question centres on investigating what climatic and non-climatic hazards culminate in environmental degradation and natural disasters. Second, the study focuses on examining the capacity of local governments to build community resilience and reduce disaster risks. Finally, the study seeks the answers to what climate-friendly technologies or solutions are practical and sustainable in the local context and how they can address disaster risks. The overarching goal of this research is to comprehensively understand the multifaceted nature of climate and disaster risks, assess the policy and institutional capacity at the local level, and explore climate-friendly technologies and solutions while linking them with broader development planning aspects. Moreover, the study aims to bridge the gap between the two strands of thinking, namely CCA and DRR, with the development paradigm. Specifically, the study seeks to:

- Understand the multiple factors contributing to climate and disaster risks.
- Assess the extent to which policies, capacity, resources, and stakeholders at the local government level are equipped to build resilience to climate and disaster risks.
- Examine climate-friendly technologies /solutions that are feasible and appropriate to the local context and understand how they can minimise disaster risks.

Overall, this study provides insights into how local communities and municipalities can effectively address climate change and disaster risks while advancing sustainable development goals locally. By understanding the factors causing environmental degradation and natural disasters and identifying effective strategies to build resilience, this research aspires to aid in developing sustainable and resilient communities.

1.7 Significance of the Study

In order to efficaciously manage disaster risks in Nepal, it is imperative to comprehend the nature and origins of hazards from diverse standpoints, such as climate, disaster, and development. By identifying the underlying causes of hazards, this study can inform the development of effective disaster risk reduction strategies and policies. Understanding the gap in the local government's policies, capacity, resources, and stakeholders related to climate and disaster will better prepare local governments and communities to respond to climatic and non-climatic disasters.

Nepal has already adopted and developed several innovative climate technologies. They should be tested and localised as per location for more prominent adaptability. Adaptation scope needs to be scrutinised in these areas; however, the understanding of climate change adaptation is contested and relative across the regions. It must be conceptualised and contextualised before devising adaptation strategies within the broader climate change adaptation and mitigation framework, to which this study will add value.

CCA and DRR integration in development planning are critical issues requiring serious attention in Nepal, particularly in policy, finance, and institutional capacity, as highlighted in the National Adaptation

Programme of Action (NAP, 2021). While Nepal has made considerable progress in developing legal and institutional frameworks to manage and reduce climate and disaster risks in recent years, more must be done to involve local communities and mainstream development planning effectively. The findings of this study will provide insights into the current state of CCA and DRR integration with development planning in Nepal and highlight the areas where further efforts are needed to ensure sustainable and resilient development planning. It will also contribute to local government mainstreaming CCA and DRR in their development planning process. This research will add to the ongoing discourse on the need for mainstreaming CCA and DRR in development planning in Nepal and other similar contexts. Understanding this interface between disaster, development, and vulnerability is essential for effective disaster management and development planning, as Higgins (2018) and Seidler et al. (2018) emphasised.

Another challenge in Nepal is the lack of information and knowledge about climate and disaster risks, which can hinder decision-making at the local level. The UNDP also notes that this will severely impact local evidence-based decision-making. Thus, this study will critically analyse existing resilient practices and support adopting context-specific climate-friendly technology in seeking practical and sustainable solutions locally.

1.8 Outline of the Report

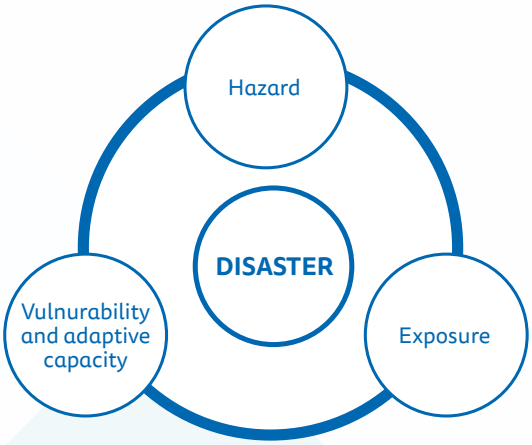
The first chapter of this report explores the interconnections between climate change, disaster, and development planning issues, focusing on the Nepalese context that sets the stage for the research problem. Additionally, this chapter outlines the study's objectives and explains how and why it is linked to a development project. Chapter 2 provides an overview of the conceptual framework that explains disaster as the outcome of the interplay between hazard, exposure, vulnerability, and adaptive capacity. Chapter 3 describes the methodology used in detail. Chapters 4 to 6 present the findings of the study. The first finding chapter discusses the relationship between climate and disaster risks and their interaction with developmental impacts, which can result in multiple hazards and disasters. The second finding chapter assesses the disaster resilience of the local government using UNDRR's Disaster Resilience Scorecard for Cities - Preliminary Level Assessment. The final finding chapter explores low-cost and locally innovative climate-friendly technologies that promote disaster resilience and climate change adaptation. An attempt is made in Chapter 7 to discuss the human element in conceptualizing hazards, increasing exposure, disasters as outcomes and choices, policy ambiguity, integrating climate change and disaster with development planning and the possibility of low-cost technologies and local innovations to minimise vulnerability and increase adaptative capacity. In Chapter 8, the study draws a conclusion based on findings and discussion. Finally, the report provides recommendations at three levels: cluster and project, local government, and national government.

2

ANALYTICAL FRAMEWORK

Understanding the dynamics of hazard, exposure, vulnerability, and adaptive/coping capacity is fundamental in comprehending disaster. The complex interplay between these factors determines the likelihood and severity of disasters. Hazards, whether natural or man-made, are not inherently disastrous on their own (Chmutina & Von Meding, 2019; Hoeppe, 2016; Clarke & Dercon, 2016). Catastrophic events only occur when hazards interact with exposure and vulnerability, resulting in loss and damage to life and property (IPCC, 2014; UNDRR, 2019; Koks, et al., 2015). It is essential to consider society's ability to manage disasters when assessing disaster risk. The lower the community's capacity to resist and absorb shocks and stresses, the greater the potential for disaster (Hartman & Squires 2006 and Wisner et al. 2004).

Figure 1: Analytical framework for the study



Therefore, the study has conceptualised the disaster frame proposed by the Intergovernmental Panel on Climate Change (IPCC) in its 5th Assessment Report as a function of hazard, exposure, vulnerability, and their combined effects. The risk has been further amplified by anthropogenic climate change impacting hazard, exposure, and sensitivity, resulting in an increased vulnerability. To reduce disaster risk, it is

necessary to minimise man-made hazards, decrease vulnerability, and relocate people and assets away from hazard exposure. Enhancing adaptive capacity is essential in reducing vulnerability and mitigating the impacts of climate change.

Hence, the study adopts this concept of disaster as an analytical framework for analysing the aspects of multi-hazard, community resilience and development planning aspects. The following definition of disaster, hazard, vulnerability, and coping capacity provided by the United Nations Office for Disaster Risk Reduction (UNDRR) is adopted in the study as a standard reference.

- Disaster: A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability, and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts.
- Hazard: A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption, or environmental degradation.
- Exposure: The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas.
- Vulnerability: The conditions determined by physical, social, economic, and environmental factors or processes which increase the susceptibility of an individual, a community, assets, or systems to the impacts of hazards.
- Coping capacity: It is the ability of people, organisations, and systems, using available skills and resources, to manage adverse conditions, risks or disasters.

Under this frame, the study identifies and unpacks various characteristics of hazards, including their type, frequency, intensity, and extent, with a primary focus on the contribution of human activities and behaviour to the processes and phenomena that lead to loss, damage, and disruption. Furthermore, exposure elements of the framework help explain the changing spatial distribution of people, infrastructure, and human assets to hazard-prone areas at the study site and how it increases the risk. The community and municipality's vulnerability, adaptive capabilities, and coping abilities are also analysed to understand better their capacity to prepare for, respond to, and recover from the impacts of hazards. Additionally, the study explores various low-cost and innovative local measures that can minimise vulnerability and increase adaptive capacity. Ultimately, the framework aims to explain the relationship between climate and disaster risks and their interaction with developmental impacts.

Landslide debris blocks river in Bajhang, triggering flood threats. 21 August 2021,
Source: The Kathmandu Post - https://tkpo.st/3z9deA2

3

METHODOLOGY

3.1 Approach

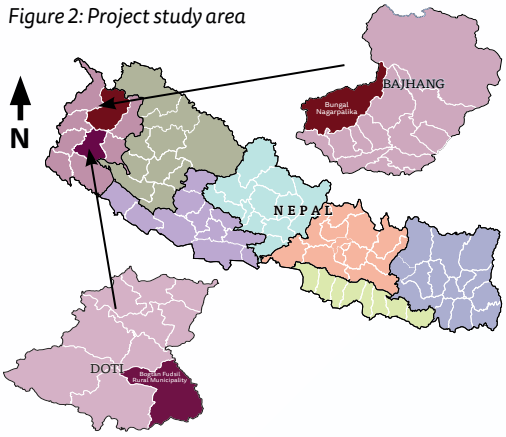
Based on the action and applied research framework, integrated research tools are developed to understand the interphase of climate and disaster risks with development. Using both deductive and inductive reasoning, researchers are better equipped to comprehend the intricate nature of climate and disaster risks at the local level. By testing pre-existing theories and generating new insights, a more nuanced understanding of the contributing factors to resilience and how they interact may be attained (Yin, 2018). A policy and capacity analysis of the municipality has been conducted to recognise institutional and policy voids to enhance the strengthening of local institutions and the capacity of human resources to achieve disaster resilience. Both science-based evidence and local knowledge have been blended that helps seek more effective climate solutions at the local level better (Bryman & Bell, 2019; Smit & Wandel, 2006).

3.2 Study Site

This present study is conducted in Doti and Bajhang Districts in the Far-western Province of Nepal. Studies have indicated that northern districts of the Surdurpachim (Far-West) provinces in Nepal are highly vulnerable to climate change impacts (Mainali, & Pricope, 2017; Shrestha et al., 2016) and equally prone to disasters (Gautam, 2017; Bhochhibhoya, & Maharjan, 2022; and MoHA, 2011) compared to other regions of the country. These districts are particularly vulnerable to the impacts of climate change due to their fragile topography, acute poverty, high natural resource dependency, and weak institutional capacity. They are equally susceptible to floods, landslides, and changes in precipitation patterns. There is also a lack of awareness and knowledge about climate change and its impacts among the local population and policymakers (Bhattarai et al., 2020). Another primary reason for carrying out the study in these locations is

because the CLIMATES project of UMN is being implemented in these two districts. This study's linkage with the project will mutually assist the study in implementing the applied research framework, ensuring reliable data collection, upscaling the research insights, and alternatively providing evidence to design better project tactics and strategies.

Figure 2: Project study area



3.3 Sampling Frame and Size

The data collection method used in this study was qualitative, involving obtaining in-depth and comprehensive data through techniques such as interviews, focus groups, and observation. The research was conducted in specific geographic areas within Doti and Bajhang Districts. Specifically, we concentrated on Bogatan Fudsil Rural Municipality in Doti district and Bungal Municipality in Bajhang district. Initially, a specific sample was not predetermined but involved only mapping major stakeholders for data collection. The data collection process began through purposive and snowball sampling. As the data collection process progressed, the point of data saturation was reached, and a sample was then finalised. A total of 26 Key Informant Interviews (KII) and 8 Focus Group Discussions (FGD), and four discussion sessions with farm-level participatory varietal trials with farmers were conducted. This approach allowed us flexibility in the initial stages of the research process while still ensuring the final sample's comprehensiveness and reflection of the context.

3.4 Methods and Tools

To explore the first research question, the researcher has followed a multi-method approach to identify climatic and human-induced hazards and various climate and disaster risks. The quantitative data on climate and disaster collected from the Department of Hydrology and Meteorology and Nepal Disaster Risk Reduction Portal was statistically analysed to examine relationships between climate variables and disaster events in Doti and Bajhang. Climate science evidence generated from the temperature and precipitation data of the last 40 years has allowed us to examine changes in average maximum temperature, average minimum temperature, and alternation in precipitation and extreme events. The quantitative secondary data assessed from the Nepal Disaster Risk Reduction Portal also identifies disasters' patterns, nature, and intensity. The local indigenous and community knowledge is used as an essential source of knowledge to validate climate data. Primary data has been gathered through interviews with senior citizens at the study site, and timeline data analysis has been conducted to document environmental degradation and climate-induced disasters resulting from increasing anthropogenic activities.

Further, the hazards (their types, frequency, extent, intensity, and causes), exposure and vulnerability components are explored in detail based on the analytical frame of disaster risk. This helps better understand the relationship between climate and disaster risks and their interaction with developmental impacts, which can lead to multiple hazards and the nature of disasters. The study team have also adopted a range of participatory tools, including focus group discussions, observation, transect walk, and

key informant interviews. These tools have been used to conduct a differentiated climate change impact analysis based on gender, age, social positionality (such as caste), cultural background, and livelihood strategies. Focus groups with women, disadvantaged groups (such as Dalits), and poor farmers have helped to capture different perspectives, conflicts, and power dynamics and to undertake 'power mapping' in climate solutions - revealing who controls what resources.

In order to investigate the policy and practice gap regarding climate change adaptation and disaster risk reduction within development planning at the local level, a review and policy analysis was conducted. It has also assessed their capacity, resources, and possible gaps for capacity enhancement. Disaster Resilient preliminary assessment scorecard has been used to identify the current status of disaster risk reduction and management in the municipality. The scorecard is structured around the UNDRR's 'Ten Essentials for Making Cities Resilient', which provides a set of assessments allowing local governments to evaluate their disaster resilience. The scorecard consists of ten essentials[1], with the first three covering governance and financial capacity, the next five focusing on planning and disaster preparation, and the last two covering disaster response and post-event recovery.

Finally, the study team undertook the assessment of climate-smart technologies that are suitable and feasible for the project areas. This involved documenting the already implemented climate-smart solutions and conducting action research to test new and innovative solutions. The study team have piloted and tested the effectiveness of firewood energy-efficient technology using improved cooking stoves in selected households and water conservation-related interventions at the community level in dry areas such as recharge ponds/pits and spring water management. The study also conducted action research on locally popular and recommended crop varieties through farm-level participatory varietal trials to improve the existing cropping system and make it more climate-resilient.

3.5 Limitations

- The precipitation climate data after 2007 obtained from Nepal's district weather stations 201 (Pipalkot, Bajhang) and 218 (Dipayal Doti) was inconsistent and superficial, limiting the analysis to exclude certain years from our analysis.
- This study is specifically focused on analysing the top four most hazardous disasters in the study area based on assessing their intensity, frequency, and extent. Consequently, other locally available hazards that do not fall within these dimensions are not explored in-depth.
- As this study is linked with the CLIMATES project of UMN, the scope of the study is limited by the project parameters such as geographical locations, available project interventions, and targeted beneficiaries. Therefore, the study cannot extend beyond these project parameters.
- The preliminary level assessment scorecard from UNDRR Disaster Resilient has been used in this study instead of the detailed level assessment scorecard. This decision was made because the study is still in the exploration stage.

1 The 10 essential includes: Essential One: Organise for Disaster Resilience Essential Two: Identify, Understand and Use Current and Future Risk Scenarios Essential Three: Strengthen Financial Capacity for Resilience Essential Four: Pursue Resilient Urban Development and Design Essential Five: Safeguard Natural Buffers to Enhance Ecosystems' Protective Functions Essential Six: Strengthen Institutional Capacity for Resilience Essential Seven: Understand and Strengthen Societal Capacity for Resilience Essential Eight: Increase Infrastructure Resilience Essential Nine: Ensure Effective Disaster Response Essential Ten: Expedite Recovery and Build Back Better

4

CLIMATE AND DISASTER RISKS

Hazard, Exposure and Vulnerability

This chapter focuses on the relationship between climate and disaster risks and their interaction with developmental impacts, which can lead to multiple hazards and disasters. The study delves into the hazards (their types, frequency, extent, intensity, and causes), exposure and vulnerability to understand the disaster risk broadly. Additionally, it examines how combined climate and other human interventions can interact and exacerbate hazardous events and disasters.

4.1 Multiple Hazards

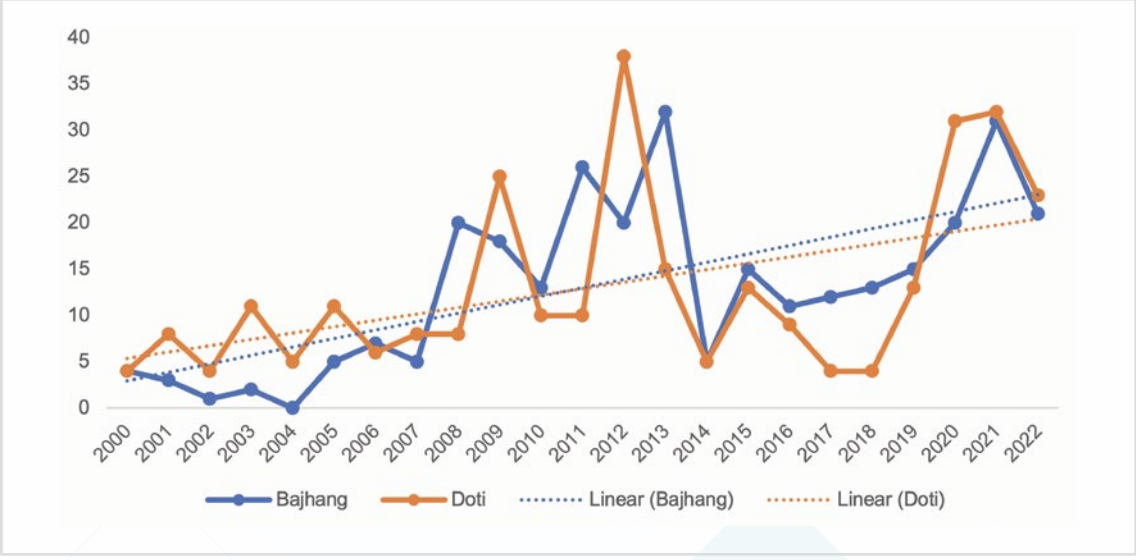
Drawing upon both primary and secondary data sources, this study identified a range of hazards that caused significant loss, damage, and disruptions at the local level. Table 1 presents the overview of the hazards identified during the field study, which had also been recorded by the National Emergency Operation Center (NEOC).

While fire, landslides, and floods were commonly occurring hazards, their impact on loss and damage was primarily determined by the frequency and intensity of landslides and floods, as indicated in Table 2. The study also found that the loss and damage caused by wildlife to people's livelihoods, the drying water springs and threats from damaging aquatic life were equally significant. Therefore, the study subsequently analysed hazards in terms of intensity, frequency, and extent at the local level to determine the most hazardous incidents.

Table 1: List of hazards (in alphabetic order)

➲ Avalanche	➲ Heavy Rainfall
➲ Crop failure due to disease and pests	➲ Landslide and soil erosion
➲ Dried water springs	➲ Loss of fishes
➲ Drought	➲ River erosion
➲ Earthquake	➲ Road accidents
➲ Epidemic	➲ Storm
➲ Fire (including Forest Fire)	➲ Thunderbolt and Lightening
➲ Flood	➲ Wildlife-induced damage
➲ Hailstone	

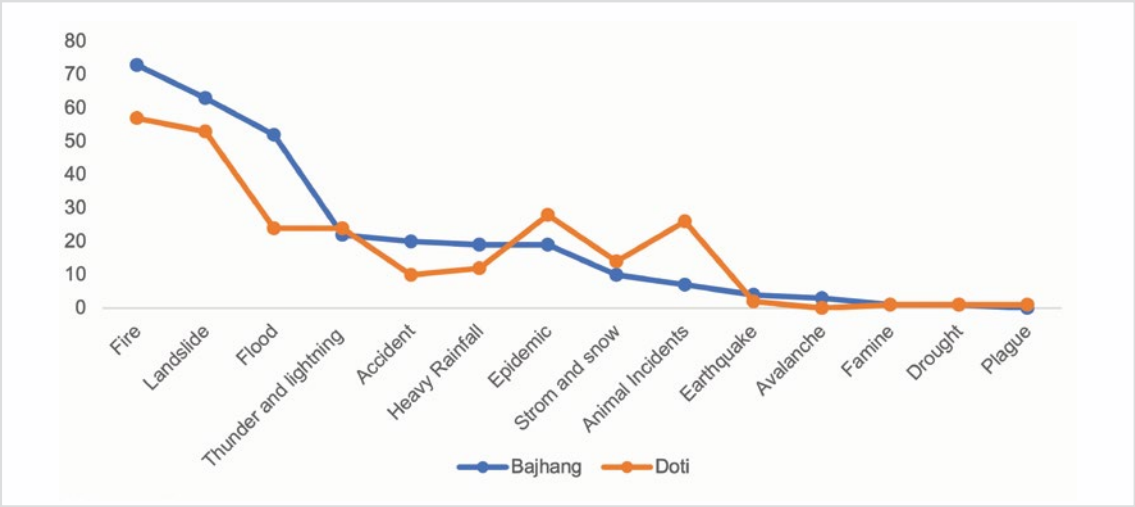
Fjghre 3: Number of disaster cases from January 2000-December 2022



Source: Calculated from Nepal DRR Portal, http://drrportal.gov.np/

Figure 3 shows the frequency of various hazards of Doti and Bajhang. A cyclical pattern was discernible upon analysing the trend; however, the incidence rate per annum demonstrated an upward trajectory or an increasing trend. Notably, Bajhang exhibited a steeper trend line in contrast to Doti, indicating a more rapid increase in the frequency of incidents. This difference can potentially be attributed to the heightened hazards resulting from the infrastructure developments underway in Bajhang. Specifically, Bajhang was host to multiple hydro-power projects, some completed and others presently under construction, along with new road heads, which contribute to the escalating occurrence of hazardous events compared to Doti (detail discussed in causes of hazards section).

Figure 4: Number of disaster incidents - 2000-2022



Source: Calculated from Nepal DRR Portal, http://drrportal.gov.np/

In a similar vein, an examination of the hazard frequencies in figure 4 revealed that the top five hazardous incidents in Bajhang include fire, landslide, flood, thunder, and road accidents, with their frequencies being higher than those in Doti. Conversely, Doti exhibited a higher frequency of fire, landslides, epidemics, animal incidents, and floods than Bajhang. However, when comparing the two districts, it was evident that fire, landslide, and flood hazards were more prevalent in Bajhang than in Doti. Thunder and lightning hazards, on the other hand, were relatively comparable in both districts. In contrast, epidemic and animal incidents were relatively higher in Doti. It is noteworthy that causality and associated losses arising from these hazards were not directly correlated but rather were contingent on the severity and magnitude of the hazards.

The table 2 delineated the losses and damages incurred due to the hazards, categorised primarily into three themes: the impact on human beings, the loss of livestock, and property damage. In both districts, epidemics, landslides, and floods ranked as the top three hazards in terms of the extent of loss and damage incurred. Notably, landslides and floods, in particular, had a considerable impact on humans, livestock, and property.

Reflecting on primary data, the loss and damage by haphazard development intervention to aquatic life and drying water springs were equally immense and frequent. Hence, analysing the hazards in terms of intensity, frequency and extent, the study identified the most hazardous incidents at the local level were:

- Landslide and soil erosion (including river erosion)
- Flood
- Dried water springs (primary information)
- Aquatic life loss (primary information)

In order to gain a deeper understanding of the dynamics associated with the most hazardous incidents identified above, the study undertook an exploration of significant reasons underlying these incidents. The following sections provide an in-depth discussion of these reasons.

Table 2: Loss and damage due to disasters in Bajhang and Doti (January 2000 - December 2022)

Incidents	Total Death	Affected Family	Injured	Cattles Loss	Displaced Shed	Govt. Houses Fully Damaged	Govt. Houses Partially Damaged	Private House Fully Damaged	Private House Partially Damaged	Estimated Loss (in USD)
Bajhang: Loss and Damage										
Epidemic	92	286	0	0	0	0	0	0	0	NA
Landslide	45	1677	23	44	7	1	0	200	166	12363
Flood	32	750	4	17	0	0	0	97	0	NA
Accident	24	0	3	0	0	0	0	0	0	NA
Fire	14	436	11	26	19	0	0	27	75	233466
Strom and Snow	7	2	1	0	1	0	0	0	2	NA
Thunder and Lightning	5	15	26	7	1	0	0	1	0	492
Avalanche	1	0	0	0	0	0	0	0	0	NA
Heavy Rainfall	0	18	1	3	0	0	0	16	3	NA
Famine	0	500	0	0	0	0	0	0	0	NA
Earthquake	0	78	0	0	0	1	0	7	18	NA
Drought	0	0	0	0	0	0	0	0	0	NA
Animal Incidents	0	7	5	0	0	0	0	0	0	NA
Total Damage	**220**	**3769**	**74**	**97**	**28**	**2**	**0**	**348**	**264**	**246322**
Doti: Loss and Damage										
Epidemic	279	1176	1567	0	0	0	0	0	0	NA
Landslide	90	11119	34	35	3	0	0	36	53	530
Flood	19	811	13	2	0	0	0	147	1	NA
Thunder and Lightning	13	25	64	0	1	0	0	0	1	37873
Accident	11	0	6	0	0	0	0	0	0	NA
Fire	10	98	10	0	12	0	0	54	10	172003
Earthquake	6	8	8	0	0	0	1	8	0	NA
Heavy Rainfall	5	373	6	0	0	0	0	3	15	1515
Strom and Snow	1	18001	0	0	0	0	0	1	2	5302
Plague	0	0	0	0	0	0	0	0	0	NA
Famine	0	0	0	0	0	0	0	0	0	NA
Drought	0	0	0	0	0	0	0	0	0	NA
Animal Incidents	0	29	32	0	0	0	0	0	0	NA
Total Damage	**434**	**31640**	**1740**	**37**	**16**	**0**	**1**	**249**	**82**	**217223**

Source: Adjusted from Nepal DRR Portal, http://drrportal.gov.np/ ; NA= Data not available. USD 1 = 130.82 NRs

4.2 Causes of Multiple Hazards

In recent years, the frequency of environmental and natural hazards, particularly hydro-meteorological hazards, were increased. Several factors induced such hazards, including climate change. Along with such hazards, there were also other haphazard development-induced hazards that were prevalent in the districts of Doti and Bajhang. This section hence explored the underlying reasons for hazardous incidents.

4.2.1 Hydro-Met Drivers

The erratic and unseasonal rainfall patterns led to a significant increase in the occurrences of landslides and floods in the region. One of the sudden and extreme rainfall of such a case occurred in the third week of October 2021. Despite Nepal's Department of Hydrology and Meteorology informing that the southwest monsoon had officially exited the country, this rare post-monsoon rainfall on 17-19 October was recorded, exceeding 500mm in Dadeldhura, an adjoining district to the study site. The rainfall-induced massive damage throughout the country, with Bajhang and Doti Districts being equally impacted. Interviewed locals in the study, including senior citizens, reported that the rainfall pattern in the region had undergone a noticeable change in recent years.

During the analysis of precipitation data from station 201, a positive trend was observed. However, the associated p-value obtained from the Mann-Kendall test was found to be relatively large, indicating insufficient evidence to reject the null hypothesis. Consequently, it is difficult to conclusively assert the presence of a significant trend in RX1day (the annual maximum one-day rainfall) and RX5day (the annual maximum 5-day rainfall). Likewise, the analysis of R95pTOT, which represents the annual amount of heavy precipitation, indicates an increasing trend in extreme rainfall magnitudes. While the observed trend in extreme rainfall magnitudes (represented by R95pTOT) is not statistically significant, there is substantial evidence to indicate the erratic nature of the rainfall pattern. This irregularity in precipitation raises concerns about the increased risk of landslides and floods.

Table 3: Analysis of extreme precipitation trend

Descriptions	RX1day	RX5day	R95pTOT
trend: tells the trend (increasing, decreasing or no trend)	No trend	No trend	No trend
h: True (if trend is present) or False (if the trend is absence)	False	False	False
p: p-value of the significance test	0.289188	0.801767	0.945025
z: normalised test statistics	1.059905	0.251061	0.068956
Tau: Kendall Tau	0.146341	0.031359	0.00813
s: Mann-Kendal's score	126	27	7
var_s: Variance S	13908.69	10724.79	7571.198
slope: Theil-Sen estimator/slope	0.45	0.172222	0.32
intercept: intercept of Kendall-Theil Robust Line, for seasonal test, full period cycle consider as unit time step	93.525	234.0194	490.54

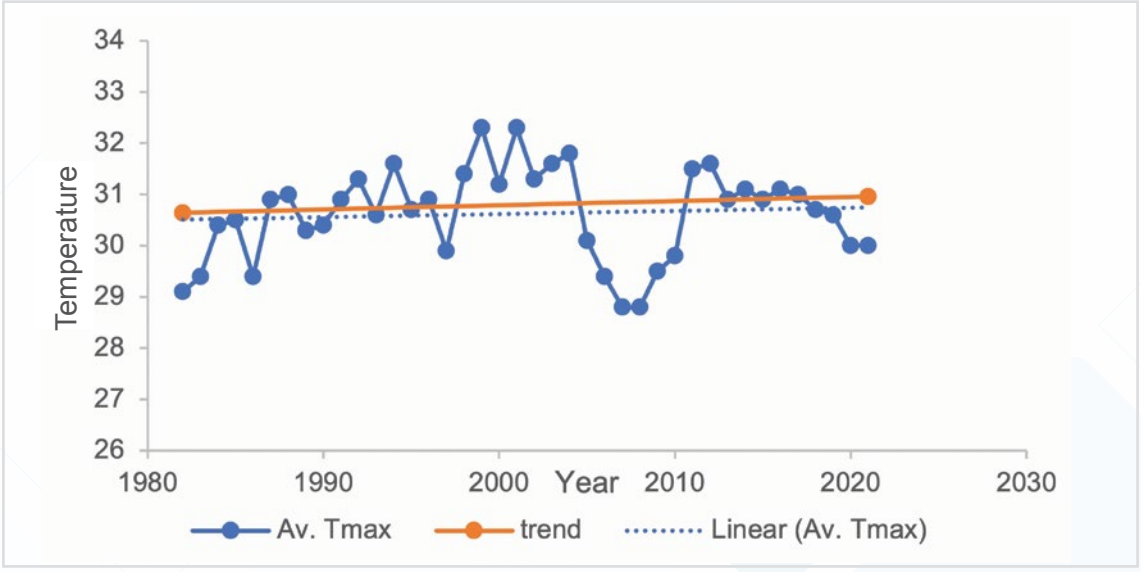
4.2.2 Climate Change

The impacts of climate change in the region have not only led to changes in average mean temperature and precipitation but have also resulted in an increase in extreme weather events. Erratic rainfall has become more frequent, with intense and unanticipated rainfall becoming a common phenomenon. Analysis of climate data indicates that there has been a rise in average maximum and minimum temperatures. Furthermore, winter rainfall has drastically declined during specific years, resulting in drought for winter crops.

An examination of climate data spanning four decades in figure 5 reveals compelling evidence supporting the occurrence of climate change. The analysis focuses on a 40-year dataset, specifically, the temperature records, which indicate a discernible rise in both the minimum and maximum temperature values. The accompanying graph depicts the temporal progression from January 1981 to December 2010 along the x-axis, while the average maximum temperature in degrees Celsius is represented on the y-axis. Notably, the graph comprises two distinct lines: a blue line corresponding to the yearly average maximum temperatures and an orange line symbolising the linear trend observed throughout the entire 40-year duration. It becomes evident from the graph that a distinct upward trend characterises the average maximum temperature over the four-decade period. The orange trend line consistently displays a positive slope, affirming the progressive increase in average maximum temperature over time. However, there is no significant trend in increase Av. Tmax even though the slope is positive.

Additionally, the graph reveals inter-annual temperature fluctuations, wherein specific years exhibit higher or lower temperatures compared to others. Nonetheless, the overarching pattern unmistakably signifies a shift towards higher temperatures. Consequently, this graph represents a valuable source of information regarding the temporal alterations in average maximum temperature.

Figure 5: Average variation of maximum temperature in dipayal in the last 40 years

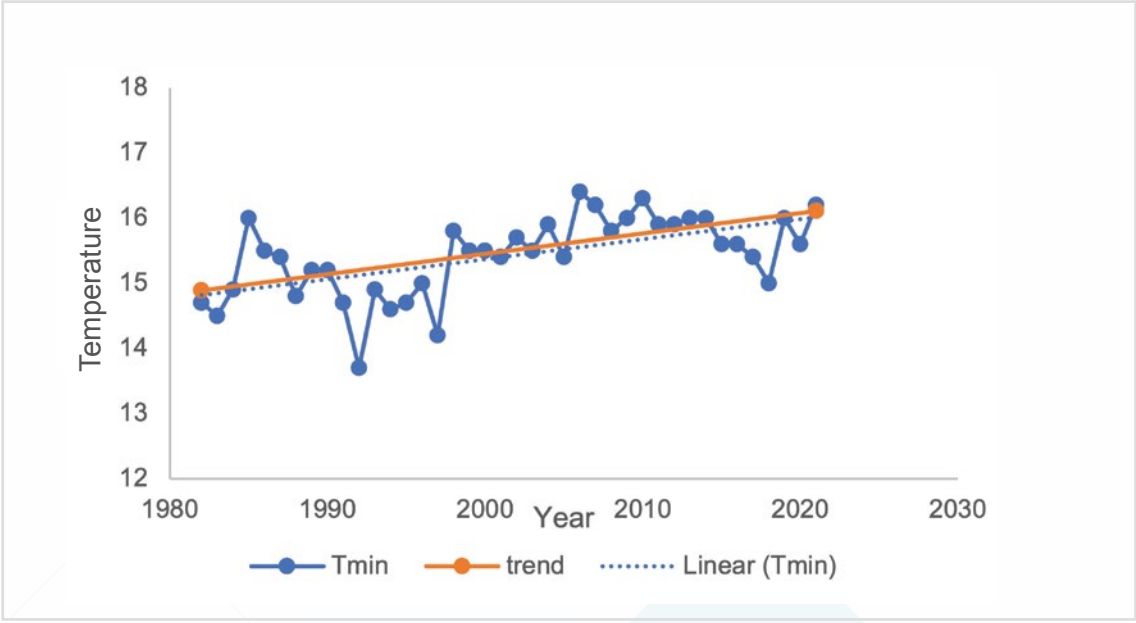


Source: DHM Nepal

The graphical representation of the average minimum temperature in figure 6 indicates a discernible upward trend. Av. Tmin represents the average minimum daily night-time temperature. There is significant trend in increase in Av. Tmin which means that the night-time temperature is increasing or nights are getting warmer. Nevertheless, it is important to note that year-to-year variations in minimum temperature introduce a certain degree of variability. However, the prevailing pattern consistently leans towards an enduring increase in minimum temperatures, which holds significant implications for various sectors reliant upon temperature fluctuations, such as agriculture, water resources, and other sectors susceptible to the influence of temperature alterations.

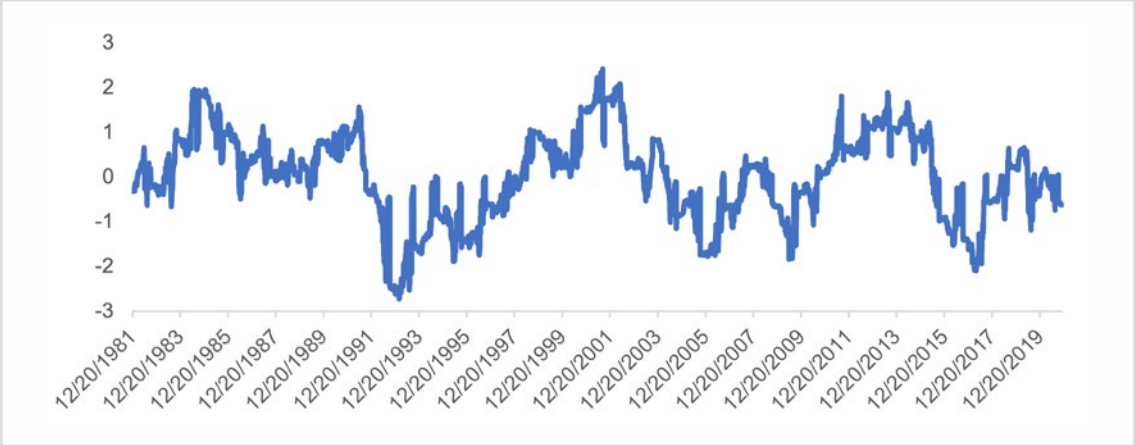
In this graph presented in figure 7, the x-axis denotes the time span from January 1981 to December 2019, while the y-axis represents the Standardised Precipitation Index (SPI) values. The blue line visually represents the SPI values pertaining to the 24-month duration. Notably, the SPI values exhibit oscillations between positive and negative magnitudes, signifying wet and dry conditions, respectively. For instance, during the early 2000s, the graph portrays extended intervals characterised by negative SPI values, indicating the prevalence of prolonged drought episodes. Conversely, the mid-1980s and late 2010s manifest protracted periods of positive SPI values, suggestive of relatively moist conditions experienced during those time frames. Collectively, the graph effectively captures the temporal variability of drought conditions spanning the 38-year period under investigation.

Figure 6: Average variation of minimum temperature in Dipayal in the last 40 years



Source: DHM Nepal

Figure 7: SPI-24 months



Source: DHM Nepal

4.2.3 Non-Climatic Driver

Haphazard Road Excavation

Hazards have even escalated with haphazard road excavation and maintenance in the study area. The desire for rural development has sparked a massive road construction craze in villages, linking it to urban as a symbol of increasing access, modernity, and development. While such development may bring increased access and opportunities, it also severely affects local communities and create victims. Usually, the local term '*Dozer Aatanka*', which translates to panic or terrorism created by the excessive use of bulldozers during local construction, is coined to explain the scale of loss and damage it has brought at the local level. There are ample cases observed where directly or indirectly, the haphazard and reckless road excavation has a severe impact on life and property. The ward chair of Bungal municipality in Bajhang district shares his observations on this issue,

> *'We dominate nature and its alignment. Engineer calculates every aspect, but their plan, map and measurement do not work here. Here, the dozer operator and the local political leader decide where the road will or should go. Definitely, if not now, the disaster will occur in future.' - Ward Chair*

Numerous road accidents, landslides and groundwater network damage were equally observed on the ground due to these reckless initiatives. Several people also reported the damaging effects of landslides triggered by haphazard road construction on their agricultural land. During a focus group discussion in Bajhang, one female participant shared that she had lost approximately 6 *Kattha* of land (approx. 8,166 square feet) at Panir Khola Ward no 4, which was one of the most fertile agricultural lands in the village. A massive landslide of road construction debris fell onto the agricultural land during a rainy day, causing irreparable damage to the soil's fertility (see page 20 picture). Another member reported that her home, including six other houses, was damaged by debris, and her six-member family is currently displaced. Other affected people in various focus group discussions in both Doti and Bajhang shared similar stories of damaged agricultural lands and displacement from their homes due to the haphazard road construction, who have lived near the road heads.

The agriculture officer at the municipality confirmed that there were various sites where landslides had destroyed homes and agricultural land, with some agricultural land being as large as 30 Ropanies (approx. 164,280 ft^2) in a single area. The Municipality's Chief Administrative Officer accepted the ongoing haphazard road excavation in their municipality and shared the complexity and lack of resources they are facing to compensate the affected households.

Haphazard excavation is not limited to roads but goes beyond. The study also found that people are excavating sloped hills to build football grounds and tourist attractions, putting downhill households at risk. Unfortunately, the landslide triggered by these excavations killed five people in 2021 and displaced several households. This haphazard excavation has also altered groundwater flow and water table. During data collection, some sites were discovered where the deep excavations had damaged the water springs leading to drying them out. Various unmanaged road networks have damaged the natural flow of stream channels and groundwater percolation, disrupting the local hydrology. In light of all these negative impacts, a teacher's statement is worth reflecting upon:

Source: Google earth

Haphazard road excavation triggering landslides, damaging fertile agricultural land at downhill.

'No one has given priority to the environment during development work. With roads reaching every part of the village, it has also increased the vulnerability to each part of the village.' - Local School Teacher

Hydro-power and Mega-Constructions

In Bajhang, specifically within Bungal Municipality, there are currently three hydro-power facilities in operation. These facilities are Sanigad Hydro, which boasts an installed capacity of 11.050 MW; Lower Kalanga Hydro, with an installed capacity of 15.33 MW; and Upper Kalangad Hydro, which has an installed capacity of 38.46 MW. The implementation of these hydro-power facilities has provided numerous benefits to the local community, including job opportunities, access to electricity, local economic revitalisation, and improved road infrastructure. Nevertheless, the aforementioned projects have also presented certain hazards alongside their developmental advantages. The construction work, specifically blasting for tunnel work, has resulted in the drying out of essential water springs that are vital to the local community's drinking water needs. One of the engineers involved in the community development project in a local NGO has shared that approximately 75-80 households relied on this water spring for their daily water needs. Unfortunately, in early 2018, the water spring dried up during the tunnel blasting work, and as a result, the affected households have had to rely on alternative water sources, which are, on average, 30 minutes away compared to the initial five-minute distance of the nearer spring.

The dam's construction has not only altered the river flow but also caused the riverbank to erode, risking the local roads and agricultural lands near the river. Another critical area of concern is the impact on aquatic life, particularly the fish population. Since the dam's construction, there has been a substantial decrease in the number of fish inhabiting the Kalanga River in Bungal municipality. Residents claim that they could previously catch 2-2.5 kg of fish within an hour, whereas now, even after several hours spent fishing, they can barely catch a maximum of 1 kg. Moreover, the size and weight of the harvested fish are also considerably lower after the dam's construction. However, locals contend that the availability of fish is abundant downstream of the hydro-power dam, as it was before, thereby establishing that the hydro dam has indeed reduced the upstream fish population.

Lower Kalanga Hydro affecting upstream aquatic life.

The study found three key factors contributing to the detrimental outcome observed in the study area. Firstly, the hydro dam located at Pauta, Bungal Municipality, has been constructed without developing a fish ladder, impeding the upstream migration of fish populations from downstream regions. This situation poses a threat not only to the fish population but also to the other aquatic biodiversity associated with fish. Secondly, debris resulting from tunnel blasting activities is being disposed of in an uncontrolled manner along the road or riverbank. According to one of the interviewed locals, the debris contains various chemicals used during the blasting process, and its irresponsible disposal can result in soil and water contamination. Fish are also susceptible to these chemicals when they come into contact with contaminated water, as locals have reported a lack of fish at these dumpsites during fishing. Finally, overharvesting fish using unhealthy fishing techniques is a pressing concern.

During an FGD on fishing practices and problems, local residents shared that the workers at the hydro-power facility had initiated using electric currents to catch fish. As per their account, the workers would submerge a wire into the water and flow an electric current to stun and kill the fish, thereby enabling them to catch large quantities of fish quickly and easily. According to the locals, this innovative fishing method caught their attention, and they learned to use batteries and inverters for fishing, covering every corner of the Kalanga River. One informant recalled that there were days when up to 40-50 people would engage in fishing simultaneously, with each person able to catch at least 2-3 kg of fish. However, the locals expressed concerns that this fishing method had not only killed larger fish but also destroyed young fish and other aquatic life during the process.

Rocks and Sand Excavation

Along with haphazard road excavations, unregulated extraction of rocks and sand from riverbeds and rocky hills is also prevalent. These rocks and sands serve as essential raw materials for local construction, be it for hydro-power projects or other community needs. According to a key informant from the local community,

> *'Bricks are rare here and expensive too. For every inch of construction work, from making houses, and road maintenance, to building boundaries for livestock, people here depend on local rocks, stones and sand. The excess use has also fueled landslides and riverbank erosion here.' - Local person during KII*

The severe erosion of the river has now expanded to the extent that it has encroached upon the periphery of a community health post located in Bijgada, Bajhang, which was constructed in close proximity to the riverbank. This development has rendered the health post particularly vulnerable to damage in the event of a flood. The informant further highlights that the erosion has also jeopardised the safety of a community school. Consequently, the unregulated extraction of these resources, in the long run, amplifies the risks of local-level hazards, particularly those pertaining to landslides and soil erosion, thereby underscoring the significance of their prudent management.

Soil erosion due to haphazard rock and sand excavation.

Unmanaged Water Channels

Another risk associated with a landslide, erosions and road accidents is the chaotic discharge of water channels over the gradient geography. The study identified three primary cases that contribute to this risk:

- The careless flow of household drainage on roads and sloping hills,
- The haphazard digging of land surfaces to divert water flows from canals to agricultural land for irrigation purposes,
- The absence of proper roadside drain channels to facilitate the appropriate downstream flow of water.

These factors are responsible for exacerbating landslides and soil erosion at the local level. The continuous water flows over time have resulted in various gorges, which are as deep as ten feet and can be observed on the hillsides and roads. These are artificial and reckless hazards waiting to escalate into a catastrophic event.

Unmanaged roadside drainage canal increasing road accident and landslide risks.

Traditional practices of digging Iijar

Traditionally, the local communities in the hilly areas of the study region have used a technique called Iijar, which involves digging a boundary ditch around 5-8 feet deep around the pastureland or on cattle shed to prevent livestock from fleeing. One of the local farmers who used to practice this technique remembers saying,

'If the cow falls into that Iijar (ditch), it cannot come out by itself. It is that big in size and depth.' - A local farmer

There is a practice to construct these ditches even on the slopped landscape. This method is prevalent in the region because building the boundary wall on pastureland with stones is labour-intensive and challenging in hilly geography. Unfortunately, the water gets trapped in the ditch during monsoon, and due to its bigger size and depth and heavy accumulation of vast volume of water, it eventually collapses, triggering the flood and landslide. The local farmer adds that he has witnessed many floods and landslides incidents in the villages due to these Iijars. Fortunately, he further claims that these practices are slowly vanishing due to their associated risk and adverse effects.

4.3 Exposure and Vulnerability

With exposure to multiple hazards, communities have become more vulnerable to disaster risks. In complex interaction of climatic and non-climatic factors, hazards are increasing with greater extent and intensity. Also, their exposure to hazards has increased with current settlement practices, migration, social settings and haphazard development interventions.

4.3.1 Exposure

The UNDRR has defined exposure as 'the situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas' (UNDRR, 2019). The study has identified exciting findings regarding people's exposure to hazard-prone areas due to migration. One of the critical observations made during the study is a gradual and permanent movement of people towards hazard-prone areas, such as road heads and river sides, from the uphill settlements. This trend was reported by a considerable number of stakeholders interviewed during the study in both districts. It is important to note that this migration trend towards hazard-prone areas may increase the vulnerability of people to natural disasters, mainly from landslides and floods. The movement towards such areas may also elevate the risk of loss and damage of life and property in the event of a disaster. A senior citizen from Bajhang expressed this concern during the study,

'The Tin-bazaar (see page 26 picture) - the newly emerged bazaar with numerous shelter and shop structures made out of just zinc sheet and hence, locally known as tin-bazaar) was all agricultural land some 8-10 years ago. People migrated from different places and started settling there for business purposes. Now it has become a dense market hub with increasing mobility of people all the time. There is a constant risk here. The river's source (Kalanga River of Bajhang) is not good as it brings much debris. Sometime back, some sections of this tin-bazaar were damaged by flood and were rebuilt.' - A senior citizen

The available evidence and trends at the local level suggest a high probability of risk associated with the newly developed settlement. The results of various FGDs in the Doti district have also echoed a similar trend of people migrating from uphill areas and settling near road heads to seek better facilities, services, and access. However, this migration trend towards hazard-prone areas reflects a significant exposure to various hazards, particularly floods and landslides, given the prevailing haphazard development works in the region. This reflects the fact that there is an increasing trend of 'people migrating from safer places to a risky place' as alerted by one local government representative.

Growing new settlement near riverside increasing exposure to disaster risk.

Source: Google Earth

In numerous regions of Doti and Bajhang, the development of schools and other public infrastructure has taken place on public lands or in an area prone to natural hazards such as floods, landslides, earthquakes, or wildfires. Such construction in areas that are prone to hazards has augmented both the degree of exposure and sensitivity. Exposure is heightened not only because these structures are situated in hazard-prone areas but also due to the institution's nature. Schools, for instance, house children who may have limited capacity to escape or make rational decisions during times of disaster and public places are frequently crowded and experience a constant flow of people, making them highly exposed and sensitive. Furthermore, sensitivity is elevated because these schools and other public infrastructures lack the design and construction to withstand such impacts from the multiple hazards in the region. The study also critically observed that there is no such practice of following building codes, which further multiplies the exposure and vulnerability.

Community schools in the disaster-prone area

4.3.2 Vulnerability

Trends in vulnerability and exposure play a notable role in driving changes in disaster risk. Although a community's exposure to the risk may be similar, the level of vulnerability can vary at the household and individual level due to their poverty status and other socio-economic factors. This context makes specific households more susceptible to the impacts of disasters and increases their vulnerability. Vulnerability can also vary depending on gender, age, social positionality (such as caste), cultural background, and livelihood strategies. Focus groups of women, disadvantaged groups (such as Dalits), and poor farmers have helped to capture different perspectives, conflicts, and power dynamics-revealing who controls what resources. In an interview, a Dalit from Bungal Municipality ward no. 4 described how recent events have made his life increasingly challenging and vulnerable. He states,

'We are landless for generations. I migrated from the upper area Ward no 4 due to discrimination of people. I have been working as a tailor from an early age. Whether we work in agriculture or tailoring, we have to work in "Khale" (the practice of paying food and grains for work) rather than "Jyalla" (the practice of paying cash for work). The "Jyalla" practice is more profitable than the Khale practice. However, community people do not prefer to pay in cash for our work. If we resist this practice, they seek other alternative people for the same job, which surely will hamper my work. Only Dalits are compelled to work in the form of Khale. Other non-Dalit usually practice the Jyalla method during work. Hence, cash transaction is very low in my work.' - Dalit (Male)

Therefore, the customary practice of remunerating with grains rather than cash for work constrains the ability of these groups to access and participate in an expanding cash-based economy and marketplace, where they migrate seeking a better livelihood. This phenomenon has rendered them even more vulnerable during times of disaster.

Local communities' vulnerability regarding food and nutrition security has been raised, mainly due to the dwindling fish populations in their Kalanga Rivers. Previously, fishing served as a significant source of supplementary food and income for over 80 per cent of the population; however, many have had to abandon this alternative livelihood due to the decline in fish populations. The construction of dams has been identified as a major cause of the decline in fish populations, as they impede the natural movement of fish. Additionally, overfishing is cited as a contributing factor, with the use of electric currents to catch fish, despite the practice being illegal under the Aquatic Animals Protection Act, 2017.

Similarly, a decline in spring water has become a significant issue affecting women in many areas of Doti and Bajhang. A notable example occurred in the Bungal Municipality, where the excavation of a hydroelectricity tunnel resulted in the depletion of spring water, thereby compelling women to cover long distances to access water for their daily needs. Such a situation not only consumes a considerable amount of their time and energy but also exposes them to various health hazards since they are compelled to collect water from potentially polluted sources. Moreover, the burden of water collection falls disproportionately on women and girls, which prevents them from attending school, engaging in income-generating activities, or participating in community life.

5

POLICY, INSTITUTIONS AND CAPACITY

Hazards that appear to be natural, such as landslides and floods, are often the result of a complex interplay between natural and human factors, making them a socio-natural phenomenon. Human actions can heighten the susceptibility of communities to such hazards and intensify their consequences. By implementing a firm policy and program at the local level, combined with the necessary capacity to execute it, the risks of disasters can be significantly reduced. The present chapter concentrates on mapping municipal resilience using a disaster resilience scorecard to assess local government's abilities to climatic and non-climatic disasters.

5.1. Policies and Institutions at a Local Level

Some of the key policies of Nepal related to climate change and disaster are the National Adaptation Program of Action (NAPA), Climate Change Policy 2019, the Framework for Local Adaptation Plan of Action (LAPA), and Nationally Determined Contribution 2020. Similarly, DRRM Act 2017, DRRM Regulation 2018 and the National DRR Strategic Plan of Action 2030 serve as significant provisions for disaster risk reduction and management. These policies enable local governments to prepare the DRRM Act, Local Disaster Climate Resilient Plan (LDCRP), and Disaster Preparedness and Response Plan (DPRP). Alongside these policies, several guidelines have also been developed to facilitate the smooth implementation of the formulated policies. These policies play a crucial role in guiding the operational measures of local governments and facilitating the proper utilisation of resources.

The municipalities of Doti and Bajhang have formulated some climate change and disaster risk reduction policies. However, these policies have been confined to the municipal level, and risk profiles, vulnerability

indices, and resilience plans are still being formulated. Despite the municipalities' allocation of funds for disaster preparedness and rescue, these resources have not been effectively utilised to meet the population's needs. Furthermore, the municipalities lack the technical capacity and human resources, which is a widespread issue for many local governments. This lack of capacity inhibits their ability to effectively plan and respond to disasters. Thus, the UNDRR Disaster Resilient preliminary assessment scorecard has been used to identify the current status of DRRM in the municipality and identify areas of improvement to become a resilient municipality.

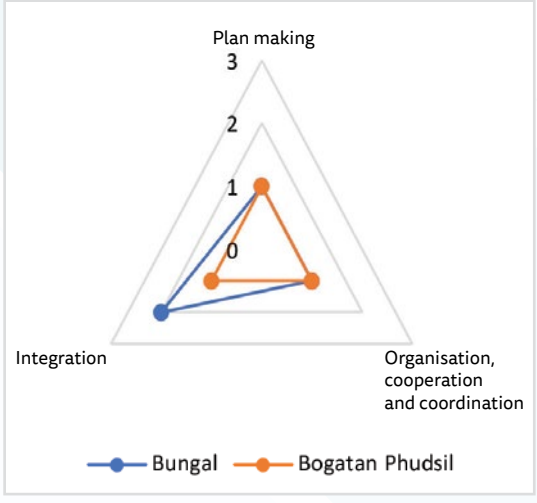
5.2 Mapping City Resilience of Bungal Municipality and Bogatan Phudsil Rural Municipality

The resilience of both Bungal Municipality and Bogatan Phudsil Rural Municipality was assessed as per their hazard assessment and financial capacity in reference to the available resources in the following criteria. The UNDRR's Ten Essentials for Making Cities Resilient, an operational framework of the Sendai Framework at the local level, presents a Ten Essentials map that aligns directly with the Sendai priorities of action and their indicators for monitoring actions on disaster risk reduction. These ten essentials assess the municipality's vulnerability, adaptive capabilities and coping abilities and are considered critical and independent steps that must be undertaken to establish and maintain resilience. The disaster resilience scorecard for cities is designed around the 'Ten Essentials for Making Cities Resilient,' which provides a set of assessments that enable local governments to evaluate their disaster resilience. The scorecard consists of ten essentials, with the first three covering governance and financial capacity, the next five focusing on planning and disaster preparation, and the last two covering disaster response and post-event recovery. The assessment was conducted in 10 thematic areas, with a score of zero indicating no progress, a score of 1 indicating little progress, a score of 2 indicating moderate progress, and a score of 3 indicating high progress. A total of 141 indicators were used under the ten thematic areas, which are considered essential for a disaster-resilient city (See Annexe 3). The detailed results of the assessment are presented in the following sections.

5.2.1 Organise for DRR Resilient City

Both Bogatan Phudsil Rural Municipality and Bungal Municipality drafted the Local DRRM Act, Local Disaster and Climate Resilient Plan (LDRCP), and Local DRR Strategic Plan of Action aligning with Sendai Framework in 2022 with support from development agencies. However, the endorsement and integration of these plans into the sectoral development plan have not yet been accomplished. Bungal Municipality has taken initial steps towards integrating DRR activities, such as road maintenance

Figure 8: Organise for DRR resilient city

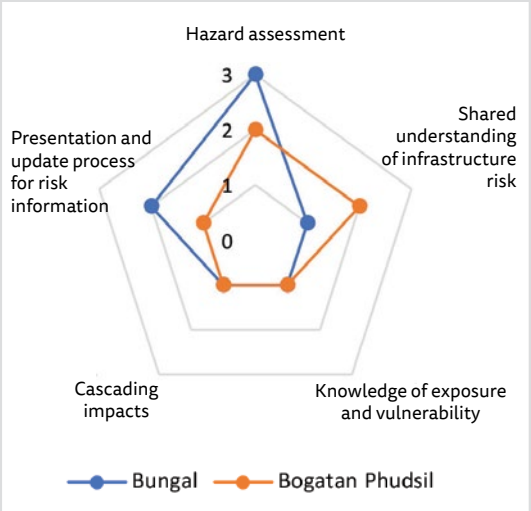


and drainage management before and after the monsoon season, into the Prime Minister Employment Program. Additionally, Bungal Municipality has engaged with the private sector, specifically the hydro-power industry, to encourage investment in DRRM activities. Both local levels have established the DRRM committee at the municipal and ward level; however, it is hardly functional. Hence, both local levels have scored nominal progress in all three indicators (Plan making, integration, organisation, coordination, and participation). As a result, they are still in the preliminary phase of their journey towards becoming DRR-resilient cities.

5.2.2 Identify, Understand and Use Current and Future Risk Scenarios

Bogatan Phudsil Rural Municipality has mapped the possible hazards that might occur using the community mapping tool. However, proper documentation and explicit multi-hazard assessment are yet to be done. Regarding the municipal understanding and shared infrastructure risk, some risks, such as preparing a gabion wall while constructing a road, constructing a concrete-based water tank in a suitable area etc., are done in consultation with the municipality, and monitoring is done accordingly. Also, the municipality clearly understands that it is the responsibility of the development agency to provide compensation for any human or property loss/ damage due to such development initiatives, and the municipality may facilitate if needed. The municipality realises that cascading impact can occur from earthquakes due to poor housing infrastructure and complex geographic structure (hilly area), but to date, no such regulatory mechanism on resilient housing construction can be found. Therefore, the municipality has scored moderate progress in hazard assessment and shared understanding of infrastructure risk however scored little progress in the remaining three themes. i.e., knowledge of exposure and vulnerability, cascading impacts and presentation and update process for risk information.

Figure 9: Identify, understand and use current and future risk scenarios



In Bungal Municipality, hazard mapping has been carried out and well documented in its LDCRP. Despite understanding infrastructure risk, municipalities remain silent on the hazard induced by hydro-power agencies as these agencies pay revenue and bring in much-appreciated jobs in the community. Bungal Municipality realises that cascading impact can occur from the flood as people move to nearby rivers to live, but no such regulatory mechanism on housing has been implemented. Therefore, the municipality has scored well in hazard assessment and presentation and update process for risk information; however, it scored little progress in the remaining three: a shared understanding of infrastructure risk themes, knowledge of exposure and vulnerability, and cascading impacts.

5.2.3 Financial Capacity for Resilience

Bogatan Phudsil Rural Municipality allocated a disaster reserve fund but did not mention the annual committed DRR fund (threshold). Similarly, DRRM fund management guideline has been prepared, but no proper channel/ source/ plan to attract the private sector and development partners has been found. Over 80 per cent of the DRR fund is spent on ex-post-disaster, response, and reconstruction. Also, the municipality does not have any provision for sectoral/ business to support resilience building. Livestock insurance is progressively increasing, but life and non-life insurance is almost nil. As a result, the municipality scored little progresses in knowledge of approaches for attracting new investment and insurance, moderate progress in the financial plan and budget for resilience, including contingency fund, and no initiation in developing incentives for resilient buildings.

Bungal Municipality has allocated funds for disasters; however, these funds are mostly directed towards relief materials instead of DRR interventions. Realising this gap, the municipality is updating its DRRM fund mobilisation guidelines. Although there are some irregular incentives in place to support resilience building, insurance related to disaster risk transfer is non-existent in the municipality. Therefore, Bungal scored similarly to Bogatan Phudsil in terms of knowledge and planning and even scored better in incentives. However, Bungal's score on insurance is lower than that of Bogatan Phudsil.

5.2.4 Pursue Resilient Urban Development

Both Bungal and Bogatan Phudsil Municipality has not prepared land use zoning or any form of urban development plan such as an integrated urban development plan, city development plan, master plan etc. Both local levels have adopted national building codes and standards for new housing construction; however, it has not been fully implemented and has not been developed by-laws. Therefore, both local levels have not scored in land use zoning, new urban development, and application of zoning,

Figure 10: Financial capacity for resilience

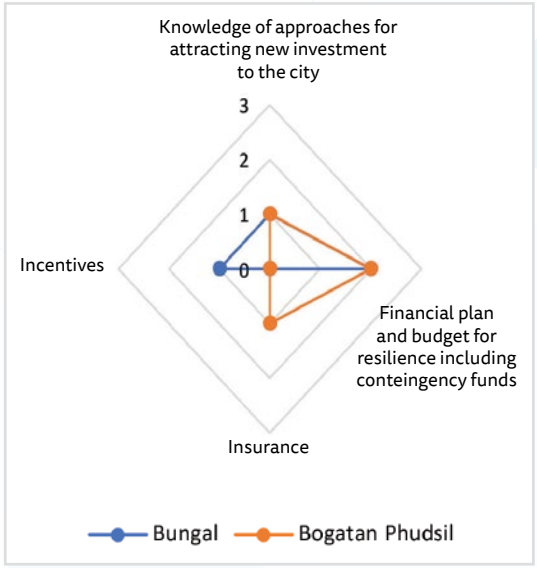
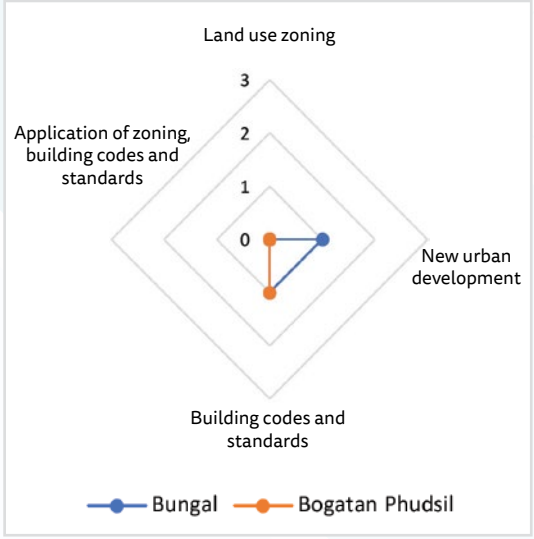


Figure 11: Pursue resilient urban development

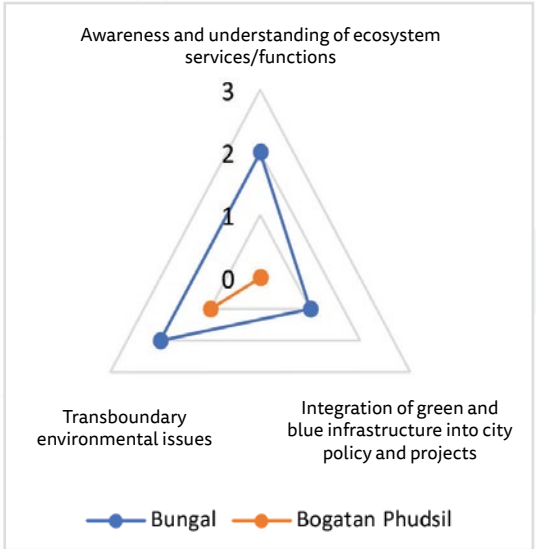


building codes and standards; however, it made little progress in building codes and standards. Bungal has a similar situation to Bogatan Phudsil on the fourth essential, except for the fact that resilience approaches are promoted but are inconsistent.

5.2.5 Safeguard Natural Buffers to Enhance the Protective Functions Offered by Natural Ecosystems

Bogatan Phudsil Municipality does not have any buffer zone/ national park or conservation area. However, community forest exists to protect the forest and the resources within it. The municipality does not have any form of blue and green infrastructure, but the majority of infrastructure is constructed based on rural natural resources (stone, mud, and wood). The municipality has no transboundary issues but depends on the market and some communities on forest resources from adjacent municipalities. Hence, the municipality scores few in transboundary environment issues but nil in the remaining two themes (See figure 12).

Figure 12: Safeguard natural buffers to enhance the protective functions offered by natural ecosystems

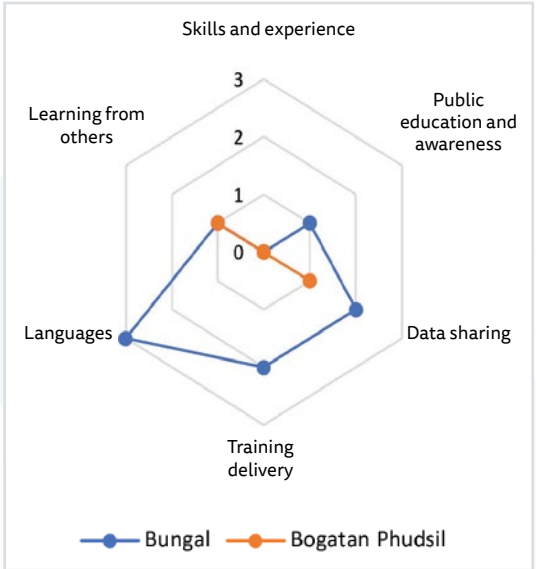


Bungal Municipality is aware of the functions provided by the ecosystem; however, the natural resources are not valued economically. The municipality promotes blue and green infrastructure, but there is no policy integrating green and blue infrastructure in the city.

5.2.6 Institutional Capacity for Resilience

The DRRM Act 2017 clearly stated establishing the DRR section and appointing DRR focal persons in the municipalities. However, in the case of Bogatan municipality, a specific department has not been formed, and an appointed municipal DRR focal person is continuously changing due to low staff retention. As a result, no proper DRR documentation and learned skills are being disseminated to the other staff and community members. The newly appointed municipal representatives are mostly unaware of the DRRM issues and initiatives. The DRRM information flow channel has been prepared, but it is not timely updated. The DRRM-related early warning is provided via local radios and miking. Also, The

Figure 13: Institutional capacity for resilience



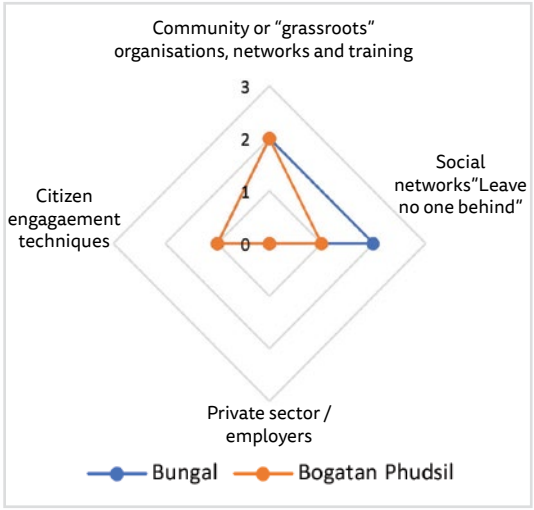
Municipality has no specific program on DRRM mainstreaming and capacity building in FY 2021/22.

Further, no initiative has been taken to prepare the awareness materials in the native language so far. Similarly, only based on ad-hoc programmes, learning, insights, and experience related to DRRM have been disseminated, but the municipality has not organised such knowledge sharing even to date. Hence, the Bogatan Phudsil Rural Municipality scores very little progress towards municipal, institutional capacity for resilience. Both of the local levels have not localised the BIPAD portal into their website to disseminate the DRRM information. Compared to Bogatan Phudsil RM, Bungal Municipality scores well in languages as most of the population has Nepali as its mother tongue, and the communication and outreach materials are also in the Nepali language. The municipality conducts awareness-raising events and training annually, and information is shared with the public.

5.2.7 Understanding and Societal Capacity for Resilience

The local development partners are highly engaged (technically and financially) in mainstreaming the DRRM in the municipality, especially in response and reconstruction. The community also provides in-kind support, such as labour donations (*Shram dan*) in reconstruction activities. However, all these initiatives are based on an ad hoc basis. Similarly, so far, non of the registered business organisation in the municipality have prepared a business continuity plan. Hence, overall it scores little progress in understanding and capacity for resilience.

Figure 14: Understanding and societal capacity for resilience



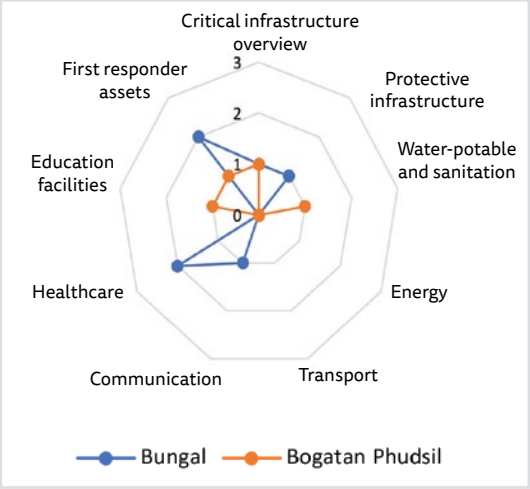
Bungal Municipality scored similarly to Bogatan Phudsil RM on all accounts except on 'leaving no one behind' components. At Bungal, the municipality has prepared the roster group of social networks available in the municipality. It has mapped the vulnerable population and provided first aid training but has not continued conducting capacity-building and refresher training activities.

5.2.8 Infrastructure Resilience

Bogatan Phudsil Rural Municipality has no such plan and has not collected information on possible infrastructure that might be affected by the identified disaster. Similarly, in case of a disaster (earthquake and flash floods) strikes, the municipality is aware that the basic infrastructure, such as water supply, electricity, transportation, communication, healthcare services, education, and business, will be significantly disrupted. However, the municipality has no infrastructure resilience awareness programme to date. The municipality lacks first responder assets, such as equipment, police, and volunteer. Therefore, the municipality scores very little on average in the infrastructure resilience theme.

Bungal Municipality does not have a critical infrastructure plan or strategy; however, some risks are understood, but not all major infrastructures are resilient. Bungal has installed protective infrastructure such

Figure 15: Infrastructure resilience

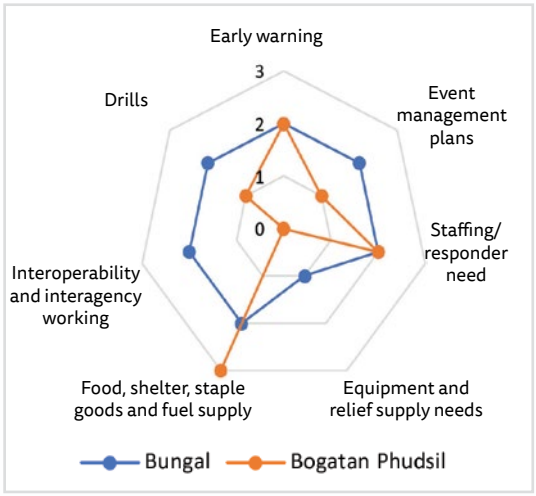


as gabion walls, but there is insufficient protection based on the risk information. Potable water, energy, transport, and communication are significantly lost when the most likely hazard, such as landslide, flash flood, and earthquake, occurs. At Bungal, healthcare is more resilient than education services. There is enough equipment for first responders, and the municipality has comparatively good stockpiled materials. Therefore, on average, the municipality scores limited progress toward infrastructure resilience.

5.2.9 Status of Disaster Response

As Bogatan Phudsil Municipality disseminates the early warning of potential hazards or disasters such as flood/landslides via radio and miking, more than 75 percent of the population could be reachable by the early warning system. However, the municipality does not have any other preparedness and response plan. The disaster management committee is established in all wards; as a result, first

Figure 16: Status of disaster response



response and information dissemination can be made within 24-48 hours; however, there is limited staff and equipment. Surprisingly, the municipality has not faced any food/staple goods shortages due to disaster events, but upon the occurrence of a disaster, there is no concrete plan except for using an alternative transportation route. The municipality has not established an emergency operation centre, and on an ad hoc basis, drills and practices for response are conducted in schools and the DRRM committee.

Bungal municipality has prepared a disaster response plan; however, there are certain gaps, such as not including the communicational channel, clear roles, and responsibilities, along with financial estimating and sources for the proposed response interventions. Despite the municipal office being understaffed, there are enough first responders to cover all neighbourhoods within 24-48 hours. The equipment and relief supplies are stocked based on guesswork rather than following the standard norms. Some core agencies participate in designing and dealing with severe hazards, and professionals validate annual drills, but so far, the municipality has not set up hazard-specific/multi-hazard early warning system.

5.2.10 Recovery and Build Back Better

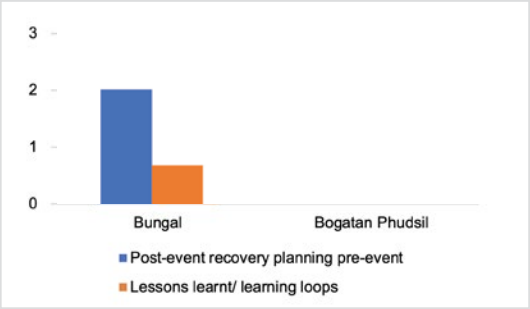
Bogatan Phudsil Rural Municipality has no preparedness and response plan and post-event recovery planning. It has been conducting post-disaster reconstruction based on the available budget and projects passed by the municipal executive committee. Also, there is no provision and habit of a lesson learnt documentation and sharing among the The Local Disaster Management Committee (LDMC). Mostly it is done only in ad-hoc based events. As a result, the municipality does not scores in any of the following themes.

Bungal Municipality has a post-event recovery plan and is well aware among the key stakeholders; however, there are certain gaps, such as the plan does not explicitly present the reconstruction intervention implementation plan, estimated funds, and its sources. The municipality practices the process of capturing and disseminating lessons learnt from the post-assessment of an event, but there is space for it to be thorough and systematic. Therefore, the municipality scores moderately in the preparation of post-event recovery planning and makes less progress in less-learnt indicators in recovery and building back better thematic areas.

5.3 Resilience of Municipality

Based on the resilience framework assessment, Bogatan Phudsil Rural Municipality and Bungal Municipality have made progress in some areas while lagging in others. They drafted Local Disaster and Climate Resilient Plans but have yet to be endorsed and integrated into sectoral development plans. Both established DRRM committees at the municipal and ward levels, but they are hardly functional. In terms of identifying and understanding risk scenarios, both municipalities have

Figure 17: Recovery and build back better



mapped possible hazards. Bogatan Phudsil Rural Municipality scored moderate progress in hazard assessment and shared understanding of infrastructure risk, while Bungal Municipality scored well in hazard assessment and presentation and update process for risk information.

Regarding financial capacity for resilience, Bogatan Phudsil allocated a disaster reserve fund and prepared a DRRM fund management guideline. However, there was no proper plan to attract private sector and development partners. Similarly, Bungal allocated funds for disasters, but these were mostly directed towards relief materials instead of DRR interventions. Both municipality have not prepared land use zoning or any urban development plan. They adopted national building codes and standards but have not been fully implemented. Both municipalities did not score in land use zoning, new urban development, and application of zoning, building codes and standards.

6

CLIMATE-FRIENDLY TECHNOLOGIES

Climate-friendly technologies and innovations are essential for disaster resilience and adaptation to climate change. Many of them are available at the local level and can be judiciously applied to bolster the resilience of local livelihoods. With slight improvements in rural technology, i.e. improving cooking stoves, it can reduce the required amounts of fuel wood. Similarly, constructing low-cost recharge pits can minimise the problem of drying springs, which is prevalent in mid-hills. The utilisation of locally available and improved seeds, as well as science-based technologies, can also assist in withstanding adverse climate conditions, such as droughts. Despite the availability of these solutions, they are often either undervalued or overhyped and poorly implemented at the local level, which can lead to increased climate and disaster risks. On the other hand, engaging communities in adopting such technologies and innovations can significantly improve their adaptive capacity and better equip them to handle future climate-related disasters.

6.1. Solar Cooking Stoves

Communities that lack access to electricity from the national grid are increasingly turning to solar power as an alternative means of meeting their daily energy needs. A solar-powered cooking stove, coupled with a small energy-efficient fan, has been identified as a simple yet effective technology that is gaining popularity among households in such communities (see page 38 picture). The locally constructed metal cooking stoves are equipped with a fan that runs on solar power, and according to local residents, the fan consumes such a negligible amount of power that it can continue to function even when the solar batteries are discharged and incapable of powering the bulb. The cost of the fan is modest, at approximately 200 Nepalese rupees (or USD 1.5), and the entire

stove, inclusive of the fan, is available for approx. 1200 Nepalese rupees (around USD 10). These devices are readily affordable, and they offer superior performance when compared to traditional cooking stoves in rural areas, especially when burning firewood. According to a female resident who cooks for a family of six individuals, the solar stove's performance is nearly twice as efficient as traditional stoves commonly used in rural communities. She says,

'Around eight Kgs of firewood is consumed when I cook a regular meal for my family in this stove (traditional stove); however, from the same amount of wood, I can cook food two times or more in this solar stove.' - Member of female group during FGD

Low-cost and energy-efficient solar cooking stove.

Another female from a different household showed the small twigs and added,

'Smaller twigs are also useful now. Initially, we do not care much about those smaller twigs while cooking and usually throw or leave them. However, now they are also useful in this solar cooking stove.' - Member of female group during FGD

The implementation of simple alternative energy sources may seem insignificant, but it has undeniably contributed to the conservation and efficient use of forest resources at the study sites.

6.2. Recharge Pond and Pits

Various climate-induced and non-climatic factors have adversely affected water availability in communities. The water table undergoes a significant depletion during the February-May months when locals claim some 80 per cent of the water sources dried out. Furthermore, the haphazard construction of roads and hydro-power projects has contributed to the drying up of spring water sources in the region.

In order to address the issue of drying up springs and the declining water table, the communities have initiated the construction of numerous recharge ponds, pits, and trenches to facilitate groundwater replenishment and natural groundwater percolation (see page 39 picture). The effectiveness of two recharge ponds located in the Doti watershed, as well as 45 recharge pits situated in a different watershed in Bajhang, has been reviewed. Communities from Doti in consultation claim,

'Initially water level starts decreasing from the month of Kartik (October-November). We even realised that the water level further decreased after the road construction uphill. However, this year a good amount of water is still flowing in the month of Mangsir (November-December) as well. This year (December 2022), it has not decreased as previously. Those water recharge initiations may have worked.' - Local person during FGD

At Bajhang, all consulted locals have agreed that the water flow has persisted for a duration of a few weeks longer than that of previous years, specifically since 2021.

Various government institutions, development organisations, and civil society groups are also actively participating in

providing technical and financial support for the recharge initiatives. According to the local engineer, these initiatives have not only increased water availability during dry months but have also aided in the prevention of landslides and floods by retaining and slowdown the overflow of water during heavy rainfalls. Furthermore, the recharge ponds support both the forest and wildlife by providing an adequate water supply.

6.3 Use of Resistant Crop Varieties and Technologies

The farming community was currently facing a range of challenges in local agriculture, primarily due to unpredictable rainfall patterns and rising temperatures. These factors put immense pressure on the farming community, making it difficult for them to grow crops effectively. To address this pressing issue, the agriculture unit of Bungal Municipality took the initiative to distribute improved seeds of wheat variety WK1204 to farmers. This particular seed variety was better suited for uphill regions and provided higher yields, and exhibited greater resistance to weather fluctuations, pests, and diseases in comparison to other seed varieties.

In addition to using improved seeds, some farmers were also cultivating local wheat varieties that are better adapted to the local climate and soil conditions. For instance, the RCDC Woman Farmer Group, a group of farmers in Bogatan Fudsil Rural Municipality Ward 7, cultivate a local wheat variety known as *Jhuse Gaun*. This variety performed well in upland areas where other improved wheat varieties may not grow well. Moreover, this local variety demonstrated resistance to Sindure diseases, which could occur due to unseasonal rainfall and lack of sunlight. By cultivating local varieties, farmers had access to seeds that were well-suited to their local conditions and could ensure a greater likelihood of success and sustainability in their farming practices.

The study conducted Participatory Varietal Trials (PVT) in the regions of Doti and Bajhang. This methodological approach was employed to assess the suitability of different wheat crop varieties, with active involvement from farmers who played a pivotal role in identifying the varieties that align best with their local climate conditions and vulnerability to natural disasters. The PVT process involved the following key steps:

Recharge pits and ponds for natural groundwater percolation to overcome water scarcity.

- Variety selection: Farmers partook in the selection process, opting for improved and local wheat crop varieties that they deemed suitable for their agricultural practices and requirements.
- Plot establishment: The chosen wheat varieties were then cultivated in small plots within a communal field with the guidance and assistance of researchers. The aim was to replicate the conditions prevailing in farmers' own fields as closely as possible, ensuring the relevance and applicability of the trial outcomes.
- Data collection: Throughout the growth cycle of the wheat crops, farmers actively observed and meticulously documented the performance of each variety. Parameters such as yield, quality, disease resistance, and other pertinent traits were taken into account. In parallel, researchers employed scientific methodologies to collect data on the same traits, providing a comprehensive and corroborative perspective.

improved variety was twice as high as that of the local variety. The production of straw, which serves as dry forage for cattle, is also considerably high. However, the local variety "*Jhuse*" is well-suited for upland conditions, where it is not feasible to cultivate improved varieties of wheat.

Farmers were subsequently encouraged to share their first-hand experiences and acquired knowledge with fellow farmers in their respective communities. This knowledge dissemination fostered the exchange of information, thereby promoting the widespread adoption of improved wheat crop varieties. Moreover, farmers extended their knowledge-sharing insights pertaining to the performance of both improved and local wheat varieties cultivated in hilly terrains. In essence, the Participatory Varietal Trials (PVTs) served as an invaluable platform for farmers to actively engage in the research and development process and enhancing crop productivity and fortifying resilience.

Table 4: Participatory varietal trial of wheat crops

S.N.	Details of Activities	District			
		Bajhang		Doti	
1	Wheat Crop Variety	*Jhuse*	WK1204	*Jhuse*	WK1204
2	Date of Sowing	2 November 2022	22 November 2022	16 November 2022	16 November 2022
3	Irrigation	2	2	1	1
4	Manure	Yes	Yes	Yes	Yes
5	Fertiliser	No	No	No	No
6	Plant Morphology	Tall	Short	Tall	Short
7	Diseases	Sindhure	No	No	No
8	Straw	33.3 MT	49.8 MT	25 MT	41 MT
9	Yield	1 MT	2 MT	0.95 MT	1.5 MT

Farmers and researchers came together to analyse the data collected at the end of the growing season. Through a comprehensive assessment, the variety denoted as WK1204 emerged as the most favourable and adaptive choice in terms of climate resilience and superior performance. The wheat yield of the

Collaborative efforts with researchers facilitated the identification and adoption of novel wheat crop varieties that exhibited enhanced suitability for local conditions, contributing to improving food security and livelihoods.

Similarly, in the regions of Doti and Bajhang, traditional terracing techniques were employed to mitigate soil erosion and preserve moisture. The terraces, locally known as '*Aalu*', were constructed on steep slopes and provided a platform for growing crops such as rice, maize and millet. Another important practice in the region is the use of mixed cropping. Farmers planted various crops in the same field, including maize, beans, and vegetables, which helped to reduce the risk of crop failure due to pests or diseases. This approach also helped to ensure that farmers have a diverse range of crops to rely on, reducing their vulnerability to changes in weather patterns.

Furthermore, to traditional terracing and mixed cropping practices, farmers in the region also practised crop rotation by cultivating lentils in alternate years with wheat. This approach helped to retain soil fertility through the nitrogen fixation ability of lentils, a legume crop. By rotating wheat and lentil, farmers improved soil health, increasing crop yields and reducing the risk of disease and pest outbreaks. Farmers also used a range of plant species and herbs to deter pests and insects that may harm their crops. For instance, marigolds are often planted around the perimeter of a field to repel insects, while neem leaves are used to control the spread of disease in crops.

Participatory Varietal Trials (PVT) of wheat crops.

7

DISCUSSION

7.1 Hazard: Natural to Socio-Natural Phenomena

Hydro-metrological hazards such as floods and landslides have become increasingly prevalent in Nepal. Empirical investigations and other evidence show a surge in the frequency of landslides and floods in recent years (Paudyal et al. 2021; Muñoz-Torrero Manchado et al. 2021). It is important to note that these events are not solely attributed to hydro-meteorological phenomena but rather escalated by anthropogenic climate change. IPCC's fifth assessment report (2014) also has projected extreme floods across the South Asia regions. In 2022, Nepal witnessed above-average precipitation levels, resulting in severe flooding and landslides throughout the country. Sudurpaschim Province alone suffered up to one-third of the paddy ready for harvest. As a result, erratic rainfall patterns have augmented the occurrence of landslides, floods, and droughts during winter.

On top of that, the continuous exploitation of natural resources, such as the hills, mountains, and trees, in the name of development has made Nepal more prone to disasters, especially during the monsoon period. Non-climatic factors such as haphazard development interventions, migration and other malpractices have also resulted in such hazards. Negligent practices, such as haphazard road construction, unregulated river sand and stone extraction, and unmanaged irrigation canals, have escalated and intensified disaster risks. Recent evidence of Bungal-4 shows that landslides hazard mainly occurs due to reckless road excavation, which buries large areas of fertile agricultural land. Notably, evidence from the literature supports the idea that natural resource exploitation and haphazard development interventions have heightened the risk of disasters (Lennartz, 2013; Muñoz-Torrero Manchado

et al., 2021; Cui et al., 2019). The influence of local political leaders and various political-economy struggles seen in the road construction project in this study also reflects that it is equally influenced by the unhealthy and vested 'politics and power' that creates a condition for disaster risks, as argued by Dixit et al. (2021). Therefore, understanding a region's hazard is incomplete without considering the socio-political context and human activities, as anthropogenic activities have the potential to accelerate or decelerate hazard processes.

7.2 Higher Exposure to Hazards

There is an increasing trend of permanent movement of people near the road heads and river sides from uphill. This shows an increasing trend of people migrating from safer locales to those fraught with risk. Consequently, these individuals are exposed to both landslides and flood hazards, rendering them vulnerable to the possibility of catastrophic outcomes. Given the existing evidence, it is pertinent to examine the ramifications of such migration. Furthermore, the construction of buildings in plain areas adjoining riversides, without adherence to building by-laws, has augmented the exposure and vulnerability of new urban settlers to floods and landslides. Akin to this, government educational institutions are often established in marginal lands proximal to riversides, as the availability of public land is abundant; however, it exposes children to the risks posed by flood and landslide events. Studies have therefore emphasised the necessity of integrating disaster risk reduction measures into school infrastructure and curricula and enforcing building codes and zoning regulations to mitigate disaster risk (UNICEF, 2012). According to some migration literature, individuals may migrate to more precarious situations, thereby compounding their vulnerability relative to their original circumstances (Kothari, 2002). In light of these findings, it can be inferred that migration does not necessarily improve the conditions of the migrants but rather may result in a heightened and enduring state of vulnerability.

Likewise, small-scale farmers have suffered significant agricultural land losses, thereby jeopardising their food security. This phenomenon is not exclusive to Nepal; in other countries, there is an emerging pattern of forced migration from safer regions to areas that pose a greater risk, particularly in the vicinity of road heads and river banks (Few et al. 2021; Thiede, Gray, & Mueller, 2016).

7.3 Disaster: Outcome of Conditions and Choices

Our unsystematic developmental pursuits have exacerbated natural hazards, which have transformed into disasters with heightened exposure and vulnerability of communities. Despite significant scope for reducing community exposure and vulnerability, such concerns have been largely disregarded. An extensive body of research substantiates the contention that human actions and choices play a pivotal role in escalating natural hazards and their conversion into disasters. For instance, a study published in the journal Environmental Science & Policy analysed the impact of human-induced land-use changes on the frequency and intensity of floods in the United States. The findings revealed that processes such as urbanisation, deforestation, and other human activities have substantially amplified the probability of flooding in numerous regions (Kundzewicz et al., 2000, Zscheischler et al., 2018). Cui et al. (2019) have also argued that human actions and conduct act as 'catalysts' in turning hazards into disasters. Likewise, the IPCC report underscores the contribution of human activities to exacerbating climate change,

thereby leading to more frequent and intense natural disasters such as droughts, heatwaves, floods, and storms (Pachauri et al., 2014, p. 151). Furthermore, a study published in the journal Natural Hazards and Earth System Sciences delved into the relationship between natural disasters and urbanisation in China. The authors discovered that swift urbanisation had caused the destruction of natural ecosystems and the depletion of natural resources, ultimately resulting in a heightened occurrence and severity of natural disasters such as landslides, droughts, and floods (Hossain et al., 2017)

Evidence suggests that human activities and choices significantly impact the escalation of natural hazards and their conversion into disasters. Therefore, it is plausible to assert that disasters do not merely arise from natural causes but rather stem and emerge from intricate socio-economic and political interactions on the ground. In essence, we create an assortment of circumstances that invite disaster. Consequently, disasters can be regarded as a manifestation of human-induced conditions and decisions. It is imperative for policymakers and communities to acknowledge this interconnection and take measures to reduce the impact of human activities on the environment and mitigate vulnerability to natural disasters.

7.4. Policy Ambiguities at the Federal and Local Level

With robust policies and programs at the local level, alongside the capacity to effectively execute them, can substantially reduce disaster risks. For instance, Birkmann et al. (2013) conducted a study that posited that disaster risk reduction policies and programs at the local level could effectively diminish disaster risks by fostering the active participation of local governments, communities, and civil society organisations. However, it is crucial to note that local-level policies and programmes in the study area have not adequately accounted for the potential of multispectral multi-scale disasters.

The approval of large-scale infrastructure projects at the federal level and their execution at the local level is a common practice. In the study area, hydropower construction has been identified as a significant contributor to community hazards. For example, road construction for hydro-power has resulted in landslides that have led to the loss of agricultural land for smallholder farmers. Furthermore, bombarding for tunnel construction has caused spring water used for drinking to dry up, while dam construction has resulted in a considerable decrease in the fish population, significantly affecting the river's aquatic life. The argument that such infrastructure projects approved at the national level and implemented at the local level have resulted in numerous hazards is supported by a range of studies. For instance, Minocha (2020) demonstrated the adverse effects of large-scale infrastructure projects, such as hydro-power plants, on local communities, leading to environmental degradation, displacement of communities, and loss of livelihoods. Such impacts negatively affect the livelihoods of the communities involved. Huynh and Stringer (2018) and Nurey (2016) emphasise the importance of considering community voices and engaging local governments in developing disaster risk reduction policies and programs that address multispectral multi-scale disasters.

Regarding Nepal's federal-level hydro-power projects, it is important to note that while their impact occurs at the local level, municipal policies alone are insufficient to bind project owners to mitigate the challenges faced by rural communities. Furthermore, local governments, on their own, are not equipped

to address the losses and damages resulting from these projects without support from higher levels of government. This means the policies and plans must be aligned across all tiers of government and formulated coherently to effectively mitigate the negative impacts of these projects. The study sees that disasters resulting from climate-induced extreme weather events require local governments to develop adaptive, flexible, and integrated disaster risk reduction policies and programs that encompass multiple sectors. This approach will help to ensure that local communities are better equipped to cope with the negative consequences of such events.

7.5 Disaster Resilience and Adaption to Climate Change:

According to the United Nations Office for Disaster Risk Reduction (UNDRR), disaster resilience is 'the ability of a system, community, or society exposed to hazards to resist, absorb, accommodate to, and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.' (UNDRR, 2017). In order to achieve this disaster resilience, disaster risk reduction (DRR) and adaptation approaches need to be mainstreamed and integrated into development policies and programs. This is also emphasised in the Sendai Framework for Disaster Risk Reduction 2015-2030, a global agreement adopted by UN Member States that aims to reduce disaster risk and prevent the creation of new risks, as well as strengthen resilience and adaptive capacity to disasters (UNDRR, 2015).

While both districts have significant policies related to DRR and climate change, it is important to note that municipalities have only basic 'Acts and Guidelines' in place for disaster risk reduction and management. This lack of comprehensive policies and regulatory frameworks at the local level can hinder the integration and mainstreaming of DRR, and adaptation approaches into development policies and programs, which can result in hazardous and disastrous development outcomes. Cutter et al. (2008) have highlighted this concern. Therefore, unless there is a significant breakthrough in plans, policies, and implementation frameworks, local governments that continue to follow a business-as-usual approach are less likely to make progress towards achieving community resilience.

7.6 Use of Climate-Friendly Technologies

Our pursuit of minimising climate and disaster risk is not always expensive and should not be only sought through the scientific community. When promoted, low-cost technologies and local innovations can essentially minimise existing constraints of large-level investment, costly measures, and scientific technologies to mitigate risk at the local level. Evidence from the United Nations Development Programme (UNDP) and the International Federation of Red Cross and Red Crescent Societies (IFRC) 2017 study reveals that communities have successfully minimised disaster risks and increased resilience despite limited resources and other constraints at the local level.

The implementation of low-cost technologies and local innovations has been found to effectively minimise disaster risks and increase community resilience in the study area. In particular, the contextual use of local and improved seeds optimally as per geography and climate. At the same time, minor improvements in rural technology, such as the construction of low-cost recharge pits and the improvement of cooking stoves, have reduced the use of fuel wood, saved

forest resources and minimised drying springs. These approaches have been shown to be effective and low-cost solutions that can help overcome the existing constraints of large-scale investments and technologies in solving the problem, widespread across Nepal. For example, the Food and Agriculture Organisation (FAO) study found that the use of locally available seeds can support communities in tolerating drought conditions, which are common in many regions. Moreover, small enhancements in rural technology, such as improvements to cooking stoves, can contribute to minimising deforestation and carbon emissions (GIZ, 2016). Furthermore, groundwater recharge initiations can help increase water availability and reduce communities' vulnerability to water-related disasters (UNESCO, 2015). Therefore, by encouraging the adoption of low-cost technologies and acknowledging local innovations, existing constraints can be overcome, and effective and sustainable risk-reduction measures can be achieved.

8

CONCLUSION

Both climatic and non-climatic hazards are rising in the ground, leading to an escalation of climate and disaster risk. This has resulted in a range of adverse effects, such as unpredictable rainfall patterns, intense rainfall events, rising of maximum and minimum temperatures, diminishing winter rains, and droughts. These effects have significantly impacted communities and their livelihoods, putting them under immense pressure. In addition, human activities have exacerbated these hazards, causing them to intensify. Meanwhile, people, agriculture, way of livelihood and human assets are increasingly being exposed to hazard-prone areas, primarily through migration to more risky areas. They are further exacerbated by poor local government policies and governance, resulting in unplanned and vulnerable settlements. Usually, in seeking better facilities, services and access, people migrate from safer places to more hazardous locations.

While looking at the capacities of the local government to deal with the climate and disaster risks, they are equally far from being able to cope with the adverse effects. This established the fact that there is a significant gap in the local government's abilities to attain disaster resilience and climate adaptation. Therefore, examining the functions of hazard, exposure, vulnerability, and capacity, the study sees high probabilistic and continuous conditions of the disaster risk in the communities. Based on the assessment of the resilience framework, both municipalities have made some progress in certain areas but have lagged behind in others. To become DRR-resilient municipalities, they need to address the gaps in their approach and implement the necessary plans and strategies.

Thus, the intricate interrelationships between climate change, disasters, and development engender complex dynamics that exert significant influence on one another. Within the specific context examined herein, haphazard human activities have contributed to the acceleration of both pre-existing and emergent hazards, thereby amplifying their overall impact. Consequently, fundamental questions arise regarding the factors underlying the transformation of development initiatives into disasters, the origins and developmental processes of disasters, and the degree of human agency in their occurrence. Although further research is imperative to provide comprehensive answers to these inquiries, encouraging community-based initiatives offers promising avenues for alleviating the consequences of climate change and disasters.

By embracing climate-friendly technologies and harnessing local innovations, communities can surmount the constraints imposed by limited resources and the absence of substantial investments. This approach empowers communities to enhance their resilience in the face of disaster risks. These community-driven endeavours, characterised by their low-cost nature, play a significant role in curtailing disaster risks while simultaneously bolstering the resilience of vulnerable communities. By adopting such strategies, communities can effectively navigate the challenges posed by climate change and disasters, safeguarding their overall well-being and resilience to sustainable development.

9

RECOMMENDATIONS

Cluster and Project

- The average minimum and maximum temperatures are rising, leading to drought and adding shock and stress to agriculture and other livelihoods that rely on climate and water. Moreover, the emergence of irregular rainfall patterns associated with climate change is posing an elevated risk, particularly with respect to occurrences of landslides and floods. In addition, the hazards in Doti and Bajhang are manifesting an increasing trajectory. Therefore, it is incumbent upon the project team and cluster to accord priority to the disaster component during their planning, intervention, and advocacy efforts.
- The need for targeted intervention in certain areas is pressing, specifically with respect to: i) landslide and soil erosion (including river erosion), ii) flooding, iii) dried water springs (as per preliminary reports), and iv) the loss of aquatic life, since these hazards were identified as being the most hazardous at the local level.
- The hazards present in the project locations are multiple and diverse, and their effects vary. Therefore, any hazard mapping exercise must be evaluated based on its intensity, frequency, and extent to ascertain the primary perilous event.
- The investigation has solely identified the top four locally significant hazardous events, predicated on their severity, recurrence rate, and scope. Nevertheless, several other hazards, including avalanches, wildlife-induced damage, epidemics, hailstones, and so forth, need equal caution from the cluster and project team in their planning, intervention, and advocacy efforts.

- The hazards are progressively taking the form of socio-natural from natural phenomena, indicating that human actions and decisions have played a decisive role in amplifying natural hazards and transforming them into disasters. Consequently, comprehending the 'hazard' in a given region is inadequate without acknowledging human activities in its framework. To address this concern, it is essential to enhance awareness and sensitise individuals to these issues, along with adhering strictly to development planning guidelines.
- In light of the fact that vulnerability and coping capacities are contingent upon gender, age, social status (e.g., caste), cultural context, and livelihood practices, interventions ought to transcend the application of blanket approaches and strategies.
- Our efforts to mitigate climate and disaster risks need not always be expensive, nor should they rely exclusively on the scientific community. Overcoming this mindset is essential. As such, we ought to promote and up-scale the adoption of low-cost technologies and localised innovations that can aid communities in minimising their vulnerability and increasing adaptative capacities to disaster risk in enhancing their resilience.
- Disasters do not solely result from natural phenomena but instead arise from complex interactions among socio-economic and political factors. Therefore, it is essential to adopt a systematic-thinking approach to analyse these issues thoroughly, to comprehend better and evaluate the situation, and ultimately to identify solutions.

Local Government

- The unregulated growth of new settlements and migration patterns is amplifying exposure to disaster risk, underscoring the need for strict regulation of building codes and settlement guidelines to ensure their appropriateness and safety.
- It is imperative that local governments carry out a comprehensive risk assessment prior to constructing public infrastructure and initiate relocating other infrastructures that are in hazard-prone zones.
- Local governments should mainstream climate change adaptation (CCA) and Disaster Risk Reduction (DRR) in their development planning process.
- Local governments are equipped with only rudimentary "Acts and Guidelines" for disaster risk reduction and management, underscoring the need for the development of comprehensive policies and regulatory frameworks at the local level. Such frameworks are necessary to integrate and mainstream disaster risk reduction (DRR) and adaptation approaches into development policies and programmes.

National Government

- Mega-development projects can have some detrimental effects that extend beyond local governments' jurisdiction to respond to the effects or to address the losses and damages. Therefore, it is crucial to align policies and plans across all levels of government and formulate them cohesively to mitigate the negative impacts of these projects effectively.
- To attain disaster resilience, it is imperative to integrate, and mainstream disaster risk reduction (DRR) and adaptation approaches into development policies and programmes.

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UNITED MISSION *to* NEPAL
PO Box 126, Kathmandu, Nepal
Phone: +977 1 4228118, 4268900
communications@umn.org.np
www.umn.org.np