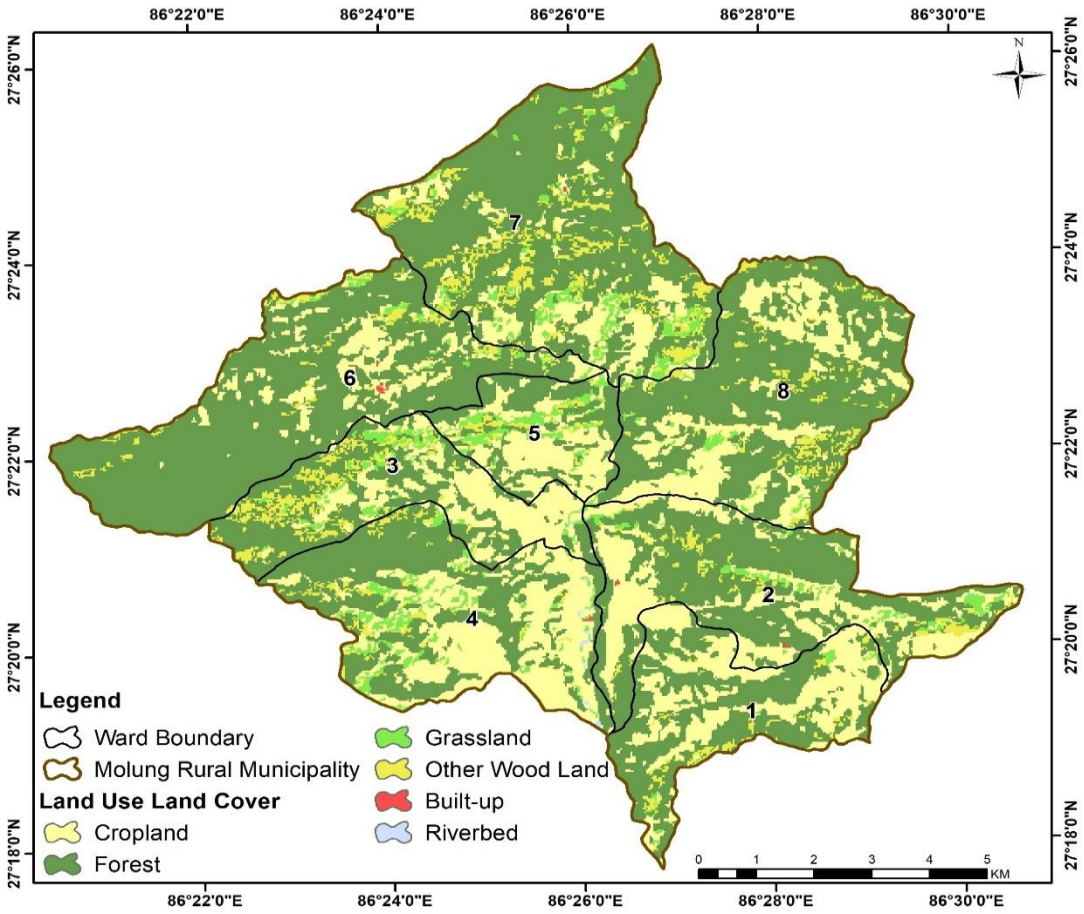
Molung Rural Municipality

Okhaldhunga, Koshi Province, Nepal

Climate Responsive Integrated Watershed Management Plan for Molung Watershed



Developing Climate Resilient Livelihoods in the Vulnerable Watersheds in Nepal (DCRL)

Government of Nepal | United Nations Development Programme

Forestry Complex, Babarmahal, Kathmandu, Nepal

Disclaimer

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Its contents are the sole responsibility of the study team and do not necessarily reflect the views of the DCRL project.

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Executive Summary

1. Background and Objective

The initiative was taken through the "Developing climate resilient livelihoods in the vulnerable watershed in Nepal (DCRL)" project implemented jointly by Government of Nepal and UNDP under financial support of Global environment Facility (GEF). The consortium of NESS-DSC-GES JV has been selected to complete the assignment "Preparation of Climate Responsive Integrated Watershed Management Plans (CRIWMP) for Molung Watershed". The main objective of the CRIWMP is to develop/formulate climate responsive evidences based on the baseline and problem analysis, and formulation of practical coping strategies for watershed planning and interventions to prepare climate resilient livelihood at both watershed and government unit level i.e. Palika level. This report is mainly focused on the Molung watershed.

2. Rational of the CRIWMP

Molung Watershed has a similar bio-physical condition; most fragile ecosystems characterized by steep slopes, fragile geology, poor agricultural potential, and water scarce area. The rationale behind a CRIWMP preparation is to identify the issues, problems, and solutions related to watershed management and ensure sustainable watershed resource management.

3. Thematic Area

Field level consultation and interaction identified that a climate-responsive integrated watershed management plan should incorporate several thematic components to effectively address the challenges posed by climate change. However, it's important to customize the plan based on local conditions, stakeholder priorities, and available resources to ensure its effectiveness and sustainability. Some recommended key thematic components for sub-watershed management are as follows: Sustainable Agriculture and Land Management; Forest and Biodiversity Conservation; Water Induced Disaster Risk Reduction; Water Resource Management; and Capacity building.

4. Methodology

The overall approach consists of primary and secondary data collection, literature review, and detailed analysis based on the baseline and field work with specific focus on study area. The work completed in three phases i.e. inception, field, and office work. In the inception phase, the team of expert initiated the collection of data, literature review of relevant studies, stakeholder consultation, detail questionnaire & checklists preparation, and ward wise high resolution google earth image in A_0 size were prepared and field execution plan were discussed and finalized with Client and stakeholder.

In field work phase, identification, selection, and training to enumerators for each Palika in consultation with Palika officials to collect the data and information from each ward of Palikas as per the prescribed format of questionnaires, checklist, maps, KII, and FGD. The team of expert did district level and Palika level consultation to validate the information collected through primary and secondary sources as discussed earlier.

In reporting phase, the collected data were analyzed, visualized, and related maps, graphs, tables, charts, and frameworks were prepared. The issue raised by client during initial sample draft presentation were incorporated and prepared draft report of all the Palikas, and those report were shared with the Client. The validation and consultation workshop at each Palika were done, information were updated and final report was prepared and submitted to the Client.

5. Plan Policy

The constitution of Nepal guarantees the fundamental right to a healthy environment and assigns powers to different levels of government for managing natural resources, including watersheds. The Local Government Operation Act empowers local governments to develop and implement watershed management plans, emphasizing community participation. The National Framework on Local Adaptation Plans for Action recognizes the importance of integrating climate change concerns into watershed management. The Fifteenth Periodic Plan focuses on coordinated implementation across all levels of government, addressing issues such as soil erosion, land rehabilitation, and water resource conservation. It emphasizes the construction of small-scale water storage facilities and renewable energy sources. However, barriers exist, including limited area coverage, funding constraints, coordination challenges, weak institutional capacity, limited awareness, and inadequate data. The plan establishes linkages between federal, provincial, and local governments. Improvised recommendations include comprehensive sub-watershed management plans, improved institutional setup, and integration of Environmental Impact Assessment with infrastructure development, capacity building, and reforestation, promotion of sustainable agriculture practices, and strengthened monitoring and evaluation.

6. Role and Responsibility

Government institutions at various levels play essential roles in implementing the watershed management plans. Federal ministries provide policy guidance, technical support, and strategic direction. Provincial ministries focus on coordination, policy formulation, and capacity building, while district-level institutions are responsible for field-level implementation. Local governments is also responsible to plan, implementation, resource mobilization, and community engagement. The successful implementation of the watershed management plan requires collaboration and coordination among these stakeholders. Through their collective efforts, they can effectively manage natural resources, address climate change impacts, and achieve sustainable watershed management, leading to improved resilience, ecosystem health, and community well-being.

7. Situation Analysis of Molung Rural Municipality

7.1 Location and topography feature

Molung Rural Municipality is located in Okhaldhunga district, Province 1 of Nepal. Molung Rural Municipality has total 8 ward distributed across 112 square kilometers of geographical area. It is surrounded by Siddhicharan Municipality in East, Khijidemba and Champadevi in West, Siddhicharan & Khijidemba in North, Sunkosi and Siddhicharan Municipality in South. The topography of Molung Rural Municipality extend from 650 m to 3016 m. Large area of Municipality fall within the topography between 1000- 1500 m. About 29% of area is covered with agriculture land, 67% area covered with forest, 5% area with grassland, and 0.1% with built-up area. Four decade of land use land cover has been analyzed for year 1990, 2000, 2010, and 2019 from the data set of ICIMOD. The pattern shows the decrease of agriculture land, with increase built-up area, grassland and forest. Three types of soil found in the Molung Rural Municipality namely Gneiss/migmatite, Quartzite and slate/Phyllite. This palika is dominant of Quartzite soil by 43%, Gneiss/migmatite by 20%, Slate/phyllite by 26%. In the Molung Rural Municipality, about 51% of Municipality come under Warm temperate climate, followed by Cool temperate (30%), sub-tropical monsoon temperate by 19%. Molung Municipality is rich in water resource. Some main river of his Municipality are Molung River, Poting River, Kul River, Gaurabari River, Dole River, Jhagarpul River, Peku River, Selpi Stream, Chauyadi stream. The sub basin of Molung Rural Municipality is approx. area of 10 km2 to 23 km2. Six sub basin fully fall under the Municipality, and Six sub-basin cover some part within it.

7.2 Socio economic condition

According to 2021 Census conducted by Central Bureau of Statistics (CBS), Molung Rural Municipality had total population of 16,440 with male 8,027 and female 8,413 and population density is 146 per kilometer square. Total number of household is 4,069 with average household size is 4. The literacy rate of Molung RM is 73.8% of which 80.7% is Male and 67.4% is Female. Higher number of people have studied Education stream followed by Management, Humanity and Science technology. Percentage of school attendance is similar for male and female, however, only 73.2% student have regular attendance. 75.5% of population are economically active and 24.4% are not active. The statistic shows that, higher involvement of people in agriculture, forestry, fishery of which 72.8% are male and 80% are female.

7.3 Agriculture and irrigation

Molung Rural Municipality has highly potential for agricultural crop production and livestock farming. Rice, maize and wheat covers 75% and oilseeds cover 15% area of total cultivated agriculture land respectively. The main source of livelihood of more than 68.8% people is agriculture which is mainly at subsistence level. Majority of the farm population (53%) in Molung Rural Municipality are landless/near landless farmers who each hold less than 0.50

ha of land. The area is facing problem of poor irrigation facility, drought, soil productivity, marketing, technical human resources, ineffective institutional arrangement, lack of implementation of crop varieties and technology, increased diseases and pests in crop and animals. Food security is one of the main problem in Molung Municipality. In Molung municipality there are only 37(0.879%) households who have sufficient foods for year and rest do not have sufficient food and they have to buy foods for consumption. About, seven small irrigation project has been implemented of total command area of 69 ha varying from 6 to 16 hectare providing benefits to about 455 households. Six small irrigation project are under construction of command area of total 42ha varying from 5 to 9 ha. Six irrigation project has been implemented from Department of Irrigation Nepal with net command area 204.6 Ha ranging from 13 ha to 66 ha

7.4 Forestry and NTFP

Out of the total area of the Palika, about 67% (7500 ha) is covered by forest (ICMOD 2019). At lower elevations, the forest types include tropical and subtropical broadleaf forests dominated by species such as Sal (*Shorea robusta*), Sissoo (*Dalbergia sissoo*), Simal (*Bombax ceiba*), Asna (*Terminalia tomentosa*), in mid hills, are Chir Pine (*Pinus roxburghii*), and Utis (*Alnus nepalensis*), Chestnut (*Castanopsis spp.*), and Chilaune (*Schima wallichii*). As the elevation increases, the forest types transition into temperate broadleaf forests characterized by species like Blue Pine (*Pinus wallichiana*), Oak (*Quercus semicarpifolia*), Walnut (*Juglans regia)*, Silver Fir (*Abies spectabilis*), Rhododendron (*Rhododendron spp.*), etc. Different Medicinal and Aromatic plants , Edible fruits and nuts , Fiber and handicraft plants Non timber Forets product (NTFP) found here. The main problems facing (NTFPs), include limited access to markets and market information, inadequate infrastructure for collection, processing, and storage, lack of value addition and product diversification, and unsustainable harvesting practices.

7.5 Multi hazard Assessment

It is estimated that about 1.01 km^2, 0.45 km^2, 0.32 Km^2 areas in Molung are under high, moderate and low flood risk zone. About 26.56 km^2, 68.79 km^2, 15.16 Km^2 areas in Molung are under high, moderate and low Landslide risk zone. 17 times fire incidence has been reported from 2017 to 2023. About 8.76 km^2, 13.3 km^2, 20.26 Km^2 areas in Molung are under high, moderate and low fire risk zone. It is estimated that about 9.89 km^2, 53.14 km^2, 47.48 Km^2 areas in Molung are under high, moderate, low soil erosion risk zone.

8. Gender Equality and Social Inclusion

This study assesses the current GESI scenario, identifying associated problems and opportunities. The study shows increase in awareness regarding Gender Equality and Social Inclusion (GESI), despite encountering some challenges. There has been an improvement in female literacy, however, numbers for higher education still indicate a lower representation compared to males. Additionally, marginalized groups face a disparity in education, primarily because of economic factors, household responsibilities. Approximately 56.5% of females and 65.5% of males are actively engaged in economic activity. Inactive Female in

economic activities, primarily due to household responsibilities and inactive male due to pursuing education or handling household chores. There are some initiatives focusing on training, awareness, and community participation. However, still various women and individuals still face challenges in actively participating and realizing the benefits of these training programs. This is often due to their existing work responsibilities, a limited appreciation of the programs, lack of suitable mechanisms to involve a wide range of individuals. To enhance inclusivity and equity, there is need to formulate comprehensive Gender Equality and Social Inclusion (GESI) plans and policies, organize gender mainstreaming training and leadership development programs, capacity development and income generation activities, targeting women and marginalized groups.

9. Outcome, output, logical framework

The outcomes of the plans are as follows:

- Outcome 1: Sustainable Agriculture and Land Management
- Outcome 2: Forest and Biodiversity Conservation
- Outcome 3: Water Induced Disaster Risk Reduction and Management
- Outcome 4: Water Resource Management
- Outcome 5: Capacity Building and Institutional Strengthening

10. Action Plan and Budget

Action plan	Estimated cost (In 000,NRS)
Outcome 1: Sustainable Agriculture and Land Management	3147200
Outcome 2: Forest and Biodiversity Conservation:	56060
Outcome 3: Water-Induced Disaster Risk Reduction and Management	160400
Outcome 4: Water Resource Management	185300
Outcome 5: Capacity Building and Institutional Strengthening	12600
Total	3,561,560

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Chapter 1: Introduction

1.1 Background of the assignment

The initiative was taken through the "Developing Climate Resilient Livelihoods in the Vulnerable Watershed in Nepal (DCRL)" project implemented jointly by Government of Nepal and UNDP under financial support of Global environment Facility (GEF). The consortium of NESS-DSC-GES JV has been selected to complete the assignment "Preparation of Climate Responsive Integrated Watershed Management Plans (CRIWMP) for Molung Watershed".

1.2 Objectives of assignment

The main objective of the CRIWMP is to develop/formulate climate responsive evidences based on the baseline and problem analysis, and formulation of practical coping strategies for watershed planning and interventions to prepare climate resilient livelihood at both watershed and government unit level i,e, Palika level. This report is mainly focused on the Molung Rural Municipality, Okhaldhunga.

To meet the above mentioned main objective, the following are three specific objectives of the study.

- To carry out a comprehensive and collaborative climate risk assessment based on the situation analysis and locally adaptive probable solutions at Local Palikas through integrated watershed management plan (IWMP).
- To recommend the sets of impactful actions, that can be replicable and scale up in other watershed that will guide the planning and interventions of watershed management activities at local levels.
- To recommend the evidence-based policy and strategies for preparing climate resilient livelihood through cooperation and collaboration for coherent mechanisms at all three tiers of governments.

1.3 Scope and Activities of the assignment

The main scope and activities of the assignment is given below:

i. Baseline information collection and analysis at both watershed and Palika level
ii. Gap analysis in existing plan, program, and policies and improvised recommendation.
iii. Assessment of watershed condition at both watershed and Palika level
iv. Assessment and documentation of cross cutting Issues at watershed and Palika level

1.4 Limitation of the study

- This study has been carried out with limited time and limited resources. Most of the information are based on the secondary information.
- Only one FGD were carried out in each ward with the participation of all the possible stakeholders from the ward office, communities. And relevant organizations.
- Cost estimation for activities is based on the prior experience, and just a thumb rule, which is also verified and discussed during the FGD.

1.5 Methodology

1.5.1 General Methodology

A research team as indicated in TOR was deployed right after the work order issued to implement the study based on understanding of the TOR. The overall approach consists of primary and secondary data collection, literature review, and detailed analysis based on the baseline and field work with specific focus on study area. The generic approach considered are:

- Mobilized a designated research team
- Interaction and consultation regularly with the Client's representative (i.e., project coordinator /technical advisor/field staff from DCRL)
- Consultation with the concerned stakeholders in the Concerned Palika
- Collection and utilization of secondary data available with the client as well as other government agencies, research institutions, Non-Governmental Organizations (NGOs) and individual researchers
- Collection of relevant primary data and information during field study/investigation,
- Review of available relevant documents/literature and incorporate them within the study scope.
- Use of state-of-the-art techniques such as geographic information system (GIS), etc.

The below flow chart shows the overall methodological framework of this study. In this study, the study team executed assignment in three phases i.e. inception, field, and office work.

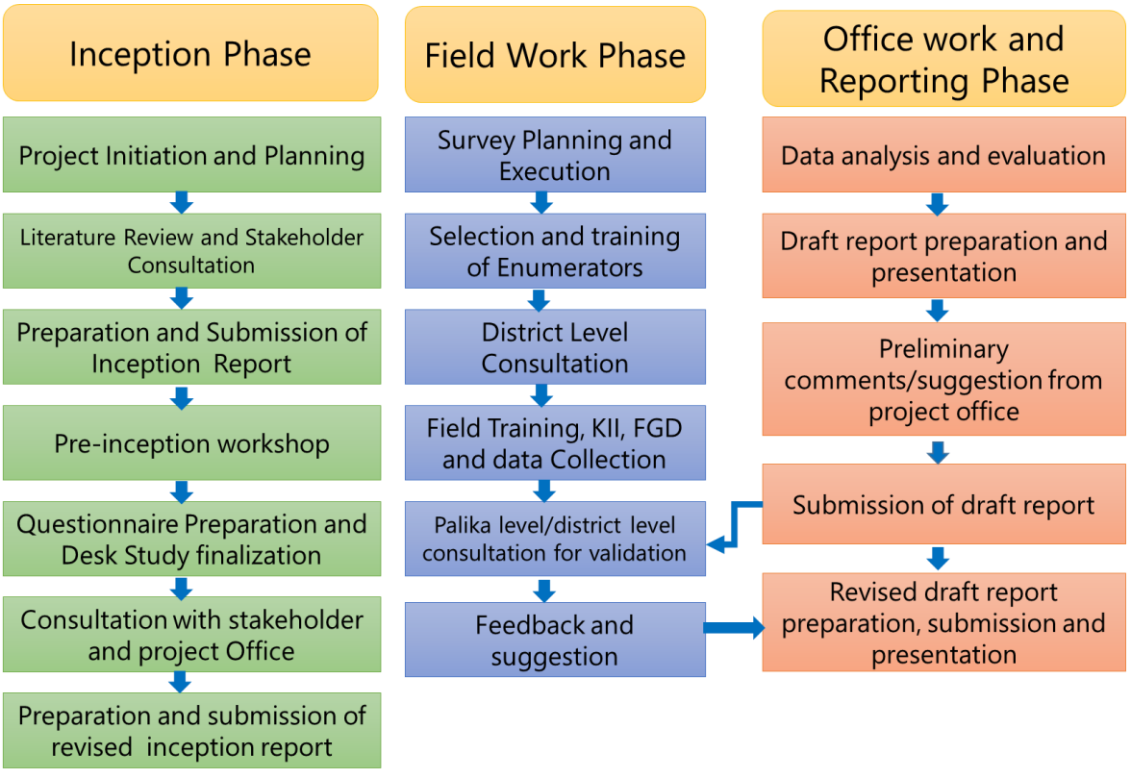

Figure 1: Overall methodological framework

1. **Inception Phase:**

In this phase the study team did the project initiation meeting and prepared the execution plan of the assignment. As per the expertise, the team of expert initiated the collection and review of the available documents, literatures, and also did the consultation with relevant stakeholder. Based on the previous studies, scope of the assignment, the study team prepared and submitted the inception report. The findings during inception phase, the detail activities, their work plan, and execution plan were discussed during the inception workshop arranged by Client. The comments and suggestion by different experts, Client's team were incorporated, detail questionnaire, checklist, and ward wise high resolution google earth image in A_0 size (attached in Annex) were prepared and field execution plan were discussed with Client and stakeholder at Client office. The comments and suggestion were during the consultation were addressed and final inception report with detail work plan submitted to the Client.

2. **Field Work Phase:**

In this phase of the study, study team identified enumerators from each Palika in consultation with Palika officials and did final selection of enumerators. Training for them were provided to collect the data from each ward of Palikas as per the prescribed format of questionnaires, checklist, and map. After the training, the team of experts visited the district headquarter and did consultation with concerned officials of different thematic areas.

Enumerators were did focus group discussion and key informant interview at ward level as a primary data collection. After first phase of field work preliminary reports were prepared and submitted to the Client based on the data collected from field. In the second phase of the field work, the team of expert did Palika level consultation workshop at each Palika on the draft report shared by Consultant to Client and Palika. Those consultation workshop help to validate the information collected during first phase of the field work and also fine tuning of proposed action plan and CRIWMP of each Palika.

3. **Office work and Reporting Phase:**

In this phase, study team did the analysis of the past studies, literature review, collected information from the field. Those data were analyzed, visualized, and related maps, graphs, tables, charts, and frameworks were prepared. Based on the analysis and agreed table of content during inception workshop, draft report prepared and submitted to the Clients. The prepared sample draft report of one Palika was shared with Client and did consultation and presentation with concerned stakeholder. The issue raised by client during initial sample draft presentation were incorporated and prepared draft report of all the Palikas, and those report were shared with the Client. The validation and consultation workshop at each Palika were done, information were updated and final report was prepared and submitted to the Client.

1.5.2 Risk Analysis Methodology

1. Flood Risk Mapping

In this project flood risk areas have been calculated based on available database and field observation. For the calculation of flood risk area we have prepared land cover database of each local level. Similarly, elevation data were prepared using spot height, contour and prepared a digital elevation model (DEM). Hydrologic parameters such as catchment area, cross-section data at defined interval, river bank lines, flow path geometry, stream center line, were observed and analysed. Discharge data at strategic point, manning's constant, river boundary information etc were observed and calculated for flood risk analysis. Other reference data were collected from survey department. For the calculation of water discharge, river/streams data were prepared watershed level discharge data were calculated for return period. Field observation and interaction with local people are further input in the study. For field observation high resolution satellite images were used to determine the high flooded area in each local level.

There is no unique definitions about flood analysis which is globally accepted. In this project comprehensive way for defining and assessing flood risk and vulnerability in the flood-prone areas. The suggested methodology follows a three-step assessment approach: a) annualized hazard incorporating both probabilities of occurrence and the anticipated potential damages; b) vulnerability (exposure and coping capacity) in the flood-prone areas; and c)

annualized flood risk (estimated on annual basis) (Figure 2). The methodology aims to assist water managers and stakeholders in devising rational flood protecting strategies.

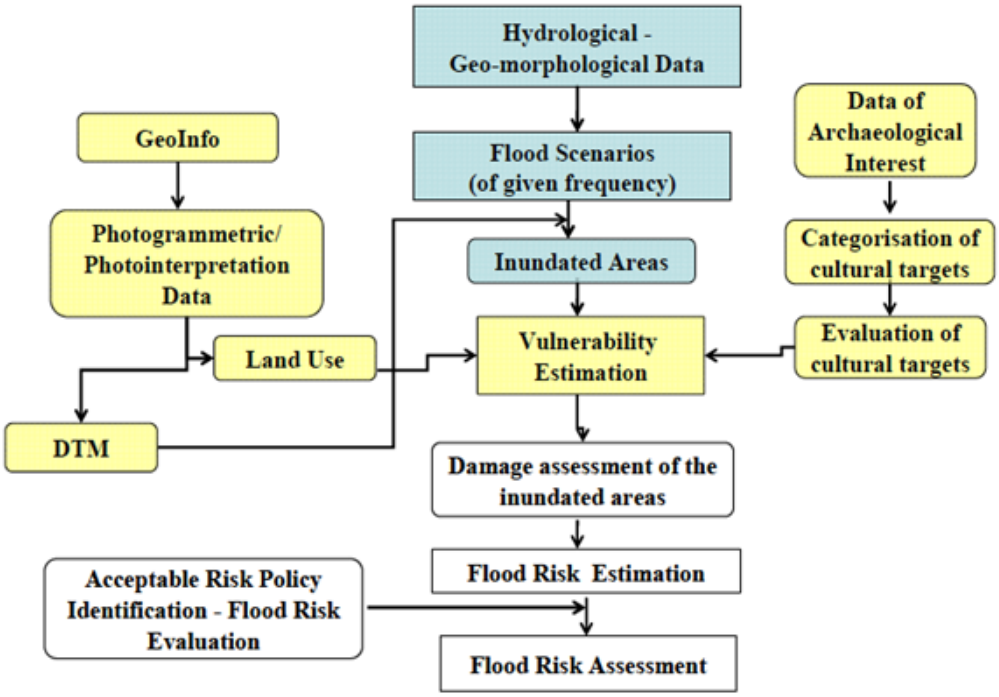

Figure 2: Methodological Framework for Flood Risk Assessment

Losses of flood have been calculated for each municipality and major watershed. Flood Risk Matrix has classes of frequencies of hazardous events and consequences or loss in the respective axes. Risk matrix were proposed based on result and mapping the risk area presented on figure 3.

FREQUENCY	High		Moderate	High	High
	Moderate		Low	Moderate	High
	Low		Low	Low	Moderate
	None	Slight/Stable			

Figure 3: Risk Matrix

i. Pre-Processing in GIS environment

Here in this part, RAS layers (Stream center line, river banks, flow path centerlines and cross-sections) were designed as shown in flow chart Figure 4. It was later followed by layer setup, and finally, RAS-GIS import file was created which was ready for processing in Hec-Ras.

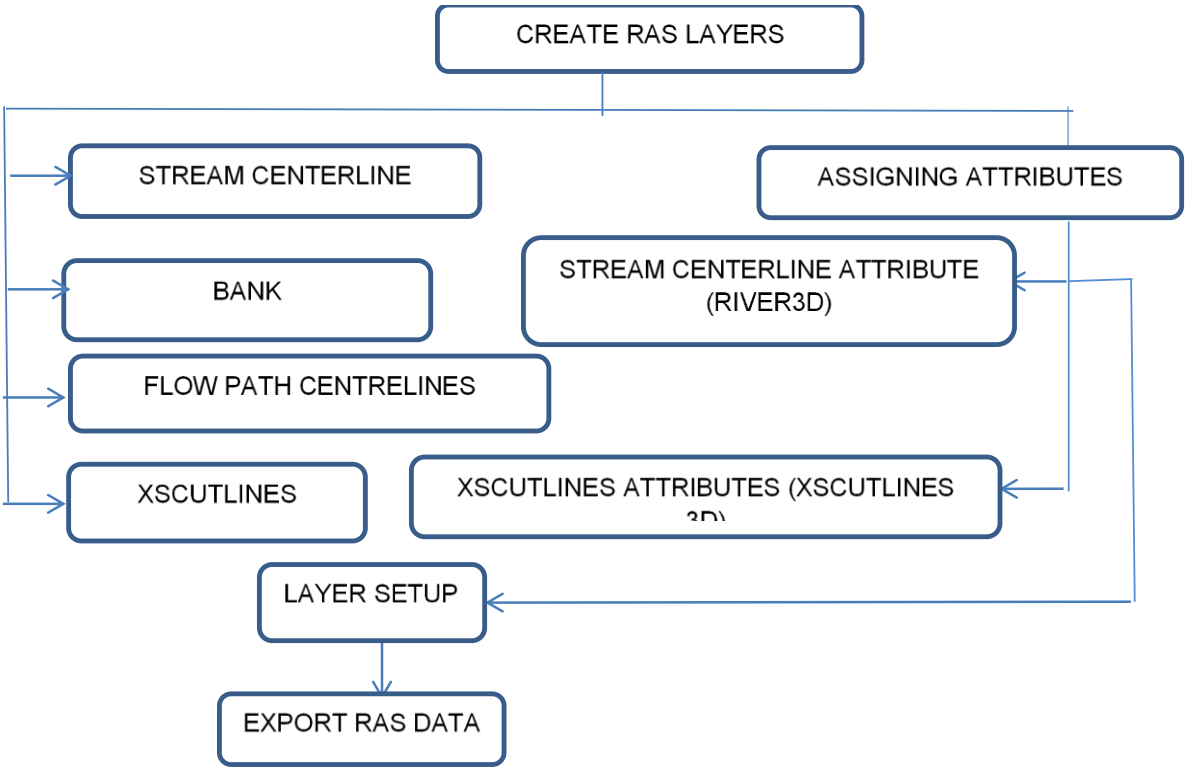

Figure 4: Pre-Processing in Hec-Georas

ii. HEC-RAS Processing

The import file thus created in HEC-Geo RAS was imported in Geometric Data Editor interface in HEC-RAS. The flood discharge for return period which was calculated using WECS/DHM method was entered in steady flow data. Reach boundary conditions were defined as critical depth for both upstream and downstream. Manning's constant for left and right bank was set as 0.04 while 0.035 was set for center of channel. Mixed analysis was done in steady flow analysis. Then the generated data is exported in GIS format. Process involved here is shown in Figure 5 and Figure 6 below.

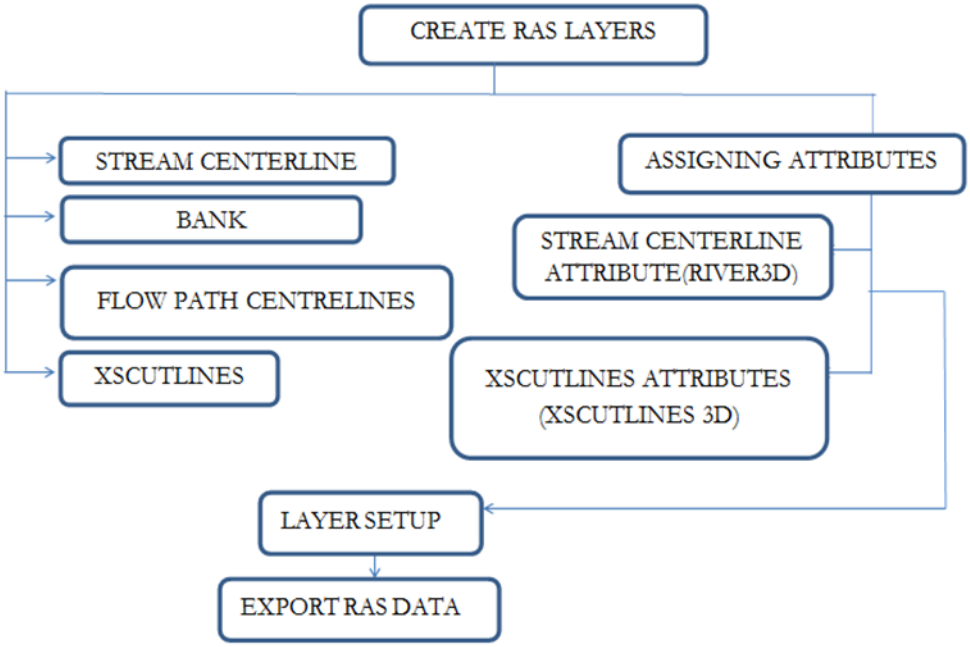

Figure 5: Preparation of database for Watershed area determination and discharge calculation

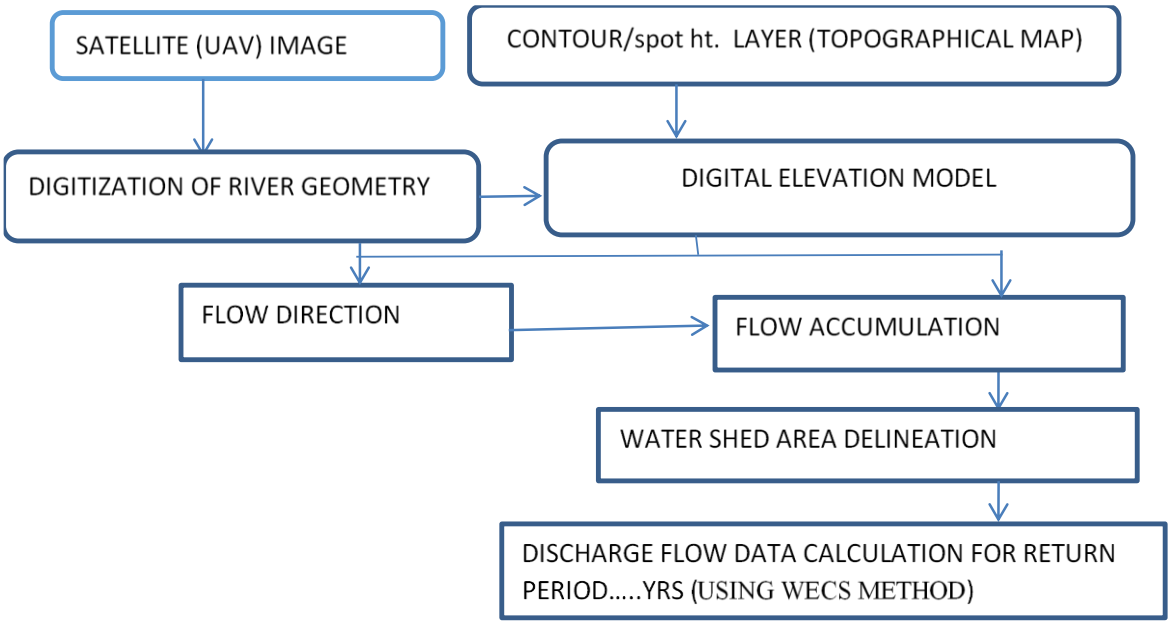

Figure 6: Process for Watershed area determination and discharge calculation

2. Landslide Risk

Landslide Risk zoning is carried out in a GIS-based system with multi criteria analysis, MCA using number of spatial data layers so that the zoning can be readily be applied for land use

planning and can be up-dated as more information becomes available. Following major database was applied for the landslide risk analysis.

i. Input data collection Method

Data collected for land use resource mapping and topographical, soil and geology data are used for landslide susceptibility analysis. Data and source of data are detailed below:

- Land cover land use (present land use, Satellite image, 2022)
- Slope and Slope Aspect (from DEM, Satellite image, 2012)
- Reference data layer of Survey Department
- Relative Relief/ Rainfall/ precipitation (derived from DEM)
- River network: Drainage density (Present land use, Satellite image 2012 & Topographical sheets, 1995-97)
- Geology: Fault and lineament, Lithology and Rock type (DoMG, 2009),
- Soil (Land system, SOTER, 2009)
- Infrastructure development data such as road construction, housing activities were used for the analysis.

ii. Landslide Risk Mapping Methodology

Landslide Risk assessments are based on different methods. Following step were taken for landslide risk assessment.

- Inventory of existing landslides from satellite image
- Verification of landslides in the field
- Mapping landslide susceptibility based on susceptibility factors integrating scientific methodology and field landslide data characteristics.

The overall methodology applied is presented in Figure 7 and the approach followed for landslide mapping includes:

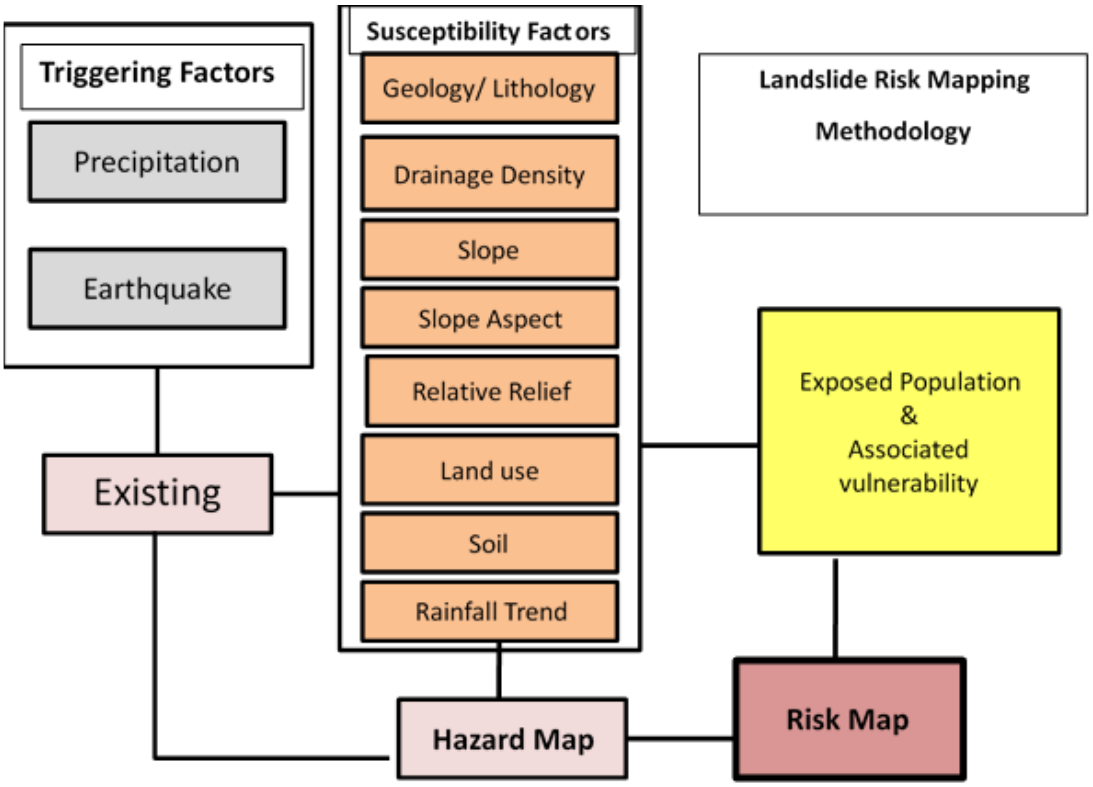

Figure 7: Landslide Risk Mapping Methodology

3. Fire Risk

It is common that forest fire occurs every year in Nepal, particularly in the forests of Terai and Churia hills. Government of Nepal has given less priority in managing forest fire due to limited resources. Nepal has adopted various forest management approaches including community forestry, leasehold forestry, protected forestry and government managed forestry. In this study we applied following method for fire risk assessment (Figure 8).

- Identification of community forest or other plantation area using satellite images and field observation.
- Identification of types of forests other plantation and present management status.
- Identifying nearby settlement areas and foot trail or road along or inside the community forest other plantation.
- Identification of risk, and its characterization with environmental effects.
- Identification of extend of fire risk area.
- Identification of settlement areas and others.
- Identification of types of settlement with present status.
- Identifying nearby industries, petro-chemical station and forest.
- Identification of probable risk, its characterization with probable environmental effects.

- Identification of extend of fire risk area.
- Identification of high-tension and Transmission line

In order to identify fire risk of any area, the visible Infrared Imaging Radiometer Suite (VIIRS) having 375 m spatial resolution active fire product, petrol pump station and transmission line location was used and analyzed.

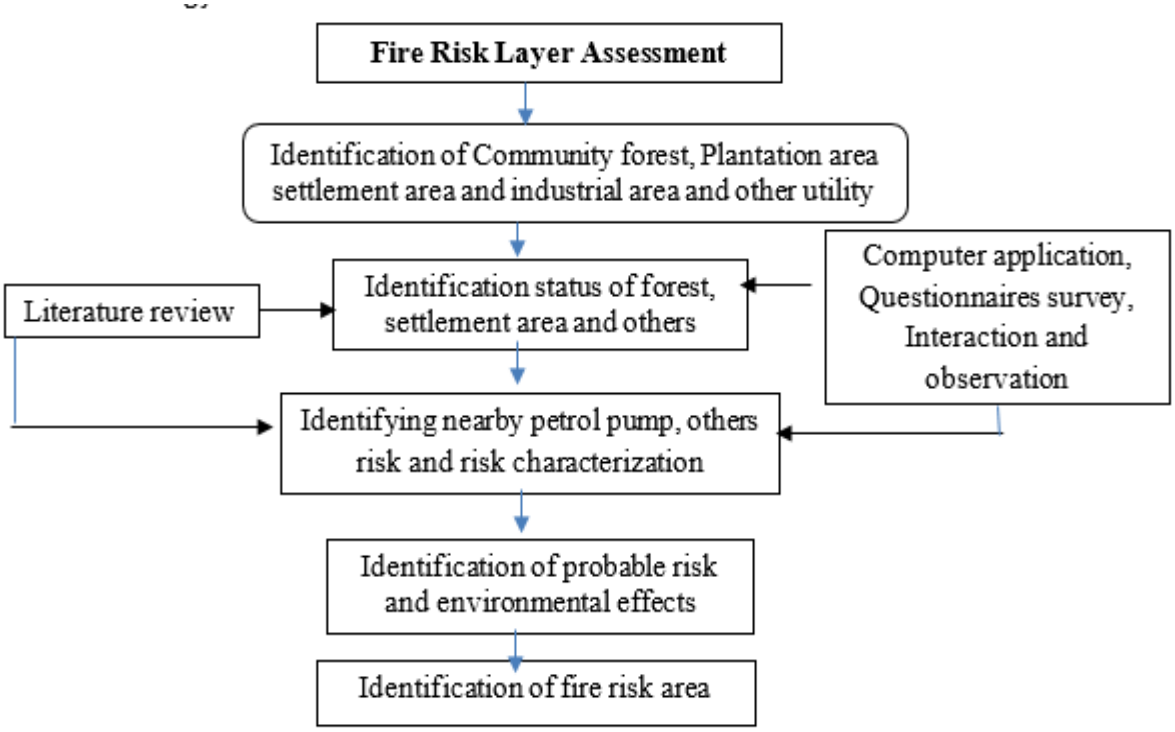

Figure 8: Fire Risk Mapping Methodology

4. Soil erosion Risk

GIS based spatial multi-criteria analysis (SMCA) method is adopted for the current assessment. The data layers used for soil erosion area were mapped using following database and methods (Figure 9).

- Land cover land use (present land use, Satellite image 2022)
- Slope (derived from DEM, Satellite image 2022)
- Slope aspect (derived from DEM, Satellite image 2022)
- River network: Drainage density (Present land use, Satellite image 2022 & Topographical sheets, 1995-97)
- Reference data layer of Survey Department
- Soil properties (Land system, SOTER 2009), and Field survey 2023
- Rainfall/ precipitation trend (DHM, 2009-2019

- Infrastructure development data such as road construction, infrastructure construction, housing activities were used for the analysis.

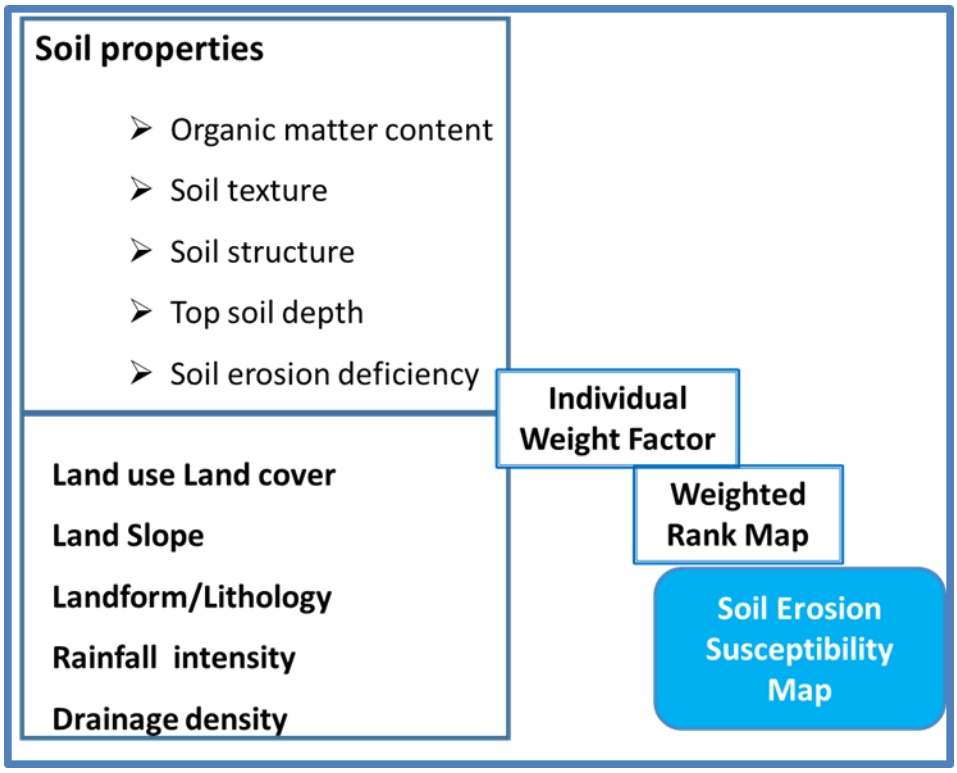

Figure 9: Soil Erosion Mapping Methodology

1.6 Review of documents related to assignment

Nepal is a mountainous country with a complex and fragile watershed ecosystem. The government has developed and adopted various policies, plans, programs, and strategies to manage its watersheds sustainably. During this study, some of the important policies, plans, programs, and strategies related to watershed management were reviewed.

1.6.1 Review of Policy, plan, program, and strategy at federal level

1. The Constitution of Nepal 2015: The constitution has recognized the importance of watershed management in sustainable development and conservation of the country's natural resources. It has recognized the fundamental right of every citizen to live in a healthy and clean environment. This provision includes the right to access clean water and protection of natural resources, including watersheds.
    i. Article 51(g) of the constitution recognizes the policy related to the conservation, protection, and use of natural resources, which includes access to clean water, renewable energy, and biodiversity. This provision implies that the government has a responsibility to ensure the sustainable management of watershed resources to protect citizens' right to a healthy environment.

ii. Concurrent Powers: The constitution has provided concurrent powers of the federal, provincial, and local governments in managing natural resources, including watersheds. This provision ensures that watershed management is integrated into the overall development planning and decision-making process at all levels of government.

iii. National Natural Resources and Fiscal Commission: Article 250 of the constitution mandates the government to establish a National Natural Resources and Fiscal Commission, which is responsible for allocating revenue and managing natural resources, including watersheds among the federal, provincial, and local governments.

2. Developing Climate Resilient Livelihood (DCRL): The project aims to enhance the resilience of watersheds and promote sustainable water resource management practices in the context of climate change. The project focused on building the capacity of local stakeholders, promoting community-based approaches, and implementing climate-resilient integrated watershed management plans.

1.6.2 Review of Policy, plan, program, and strategy at Province Level

The Koshi province has formulated its own specific policies, strategies, and acts related to forest and environmental protection. Various programs and plans have been developed and implemented through different line ministries to address the issues related to soil erosion, forest degradation, water scarcity, water induces disasters, and climate change impacts.

1.6.3 Review of Policy, plan, program, and strategy at Local Level

1. Local Government Operation Act, of 2017: It empowers the local government to develop and implement watershed management plans and programs at the local level, emphasizing the conservation, development, and sustainable use of water resources, forests, and other natural resources within the watershed. The act mandates the formation of a natural resource management committee in each local government to manage and conserve natural resources, including watersheds. It also emphasizes the active participation of local communities in decision-making and implementation processes.

2. National Framework on Local Adaptation Plans for Action (2011): It recognizes the integration of climate change concerns into watershed management practices, recognizing the interrelationship of water resources, ecosystems, and climate impacts. It has provisions for the identification and assessment of vulnerable areas and the development of targeted adaptation strategies for watershed management. It also emphasizes the involvement of local communities in planning and decision-making processes, ensuring their active participation and ownership. The framework also

emphasizes the importance of building local capacity and knowledge on climate change adaptation and watershed management, and the need for effective coordination and collaboration among stakeholders at local levels to achieve sustainable and climate-resilient livelihood outcomes.

1.6.4 Provision of Fifteenth periodic plan (2019-2024)

The provision of integrated watershed management is an important component of this plan. The key provisions related to watershed management in the Fifteenth Periodic Plan of Nepal:

- Watershed management programs will be implemented in a coordinated manner across all three levels of government (federal, provincial, and local) to ensure effective management of water resources.
- Watershed management programs will be implemented with the active participation of local communities, especially marginalized groups such as women and ethnic minorities.
- Watershed management programs will focus on landslide treatment, river bank protection, degraded land rehabilitation, promoting sustainable land use practices, including agro-forestry, and the promotion of site-specific low-cost and bio-engineering techniques for different ecological regions.
- Watershed management programs will prioritize the conservation of water resources, including the construction of small-scale water storage facilities such as ponds and check dams.
- Watershed management programs will also focus on promoting the use of renewable energy sources such as biogas, solar, and wind power to reduce reliance on non-renewable sources of energy.

1.6.2 Barriers and gaps in the policy, plan, program and strategy to execute prescribed activities in CRIWMP

In spite of the various provisions in policies, plans, programs, and strategies related to watershed management, there are several barriers and gaps that hinder their effective implementation. Some of the significant barriers and gaps in the policy, plan, program, and strategy of watershed management are:

1. Limited area coverage: One of the gaps in watershed management is limited area coverage. Sub-watershed management planning guidelines (2016) make the provision to delineate the functional sub-watershed area of 15-25 square kilometers for planning which covers small 5 to 10 % of the total area of the district. Sub-

watershed management plans though implemented did not cater to poorer people's needs and problems for a lack of social parameters such as poverty information and lack of adequate community consultation in the planning process, which has been one of the stumbling blocks for non-replication of SCWM interventions by people at large.

2. Limited funding: Another significant barrier to effective watershed management in Nepal is the limited funding available for implementing policies, plans, programs, and strategies related to watershed management. This limits the capacity of local governments to undertake activities such as soil conservation, water resource management, and development of water infrastructure.

3. Lack of coordination: There is a lack of coordination and collaboration among various government agencies, non-governmental organizations (NGOs), and community-based organizations (CBOs) involved in watershed management. This hinders the effective implementation of policies, plans, programs, and strategies related to watershed management.

4. Weak institutional capacity: There is a lack of institutional capacity and human resources at the local level to undertake watershed management activities. This includes a lack of technical expertise, training, and resources to undertake activities such as soil conservation, on-farm conservation, water resource management, and development of water infrastructure.

5. Limited awareness and education: There is limited awareness and education among local communities about the importance of watershed management and the impact of their actions on water resources. This limits the capacity of local communities to participate effectively in watershed management activities.

6. Lack of data and information: There is a lack of accurate and up-to-date data and information on water resources and watershed management activities in Nepal. This limits the ability of government agencies, NGOs, and CBOs to make informed decisions and implement effective watershed management activities.

1.6.4 Government linkage in policy, plan, program and strategy

The management of watersheds in Nepal involves multiple tiers of government, including the federal, provincial, and local levels. The linkages between the governments in each tier are outlined below:

1. Federal Level: At the federal level, the Ministry of Forests and Environment is responsible for developing policies, plans, programs, and strategies related to watershed management. The ministry collaborates with other federal agencies such as the Department of Water Resources and Irrigation, the Department of Soil

Conservation and Watershed Management, and the Department of National Parks and Wildlife Conservation to implement these policies and plans.

2. Provincial Level: At the provincial level, the Ministry of Tourism, Forests and Environment is responsible for implementing federal policies, plans, programs, and strategies related to watershed management. The provincial government works closely with local governments to identify and prioritize watershed management initiatives based on local needs and resources. The provincial government also coordinates with federal agencies to ensure that their initiatives align with federal policies and plans.

3. Local Level: At the local level, the Rural Municipality (RM) and Municipalities are responsible for implementing the watershed management initiatives in their respective jurisdictions. The RM/Municipality collaborates with other local government entities such as the District Coordination Committee (DCC) as well as the province level to develop and implement policies, plans, programs, and strategies related to watershed management. The local government entities also work closely with local stakeholders such as farmers, community groups, and NGOs to ensure that their initiatives meet local needs.

1.6.5 Improvised recommendation in policy, plan, program and strategy

Molung watershed characterizes with highly diverse landscapes, ranging from the mid Mountains, tars, and small plains. Those watersheds are rich in water resources, which makes it highly dependent on water resources for agriculture, drinking water, and hydropower generation. However, due to various anthropogenic activities and climate change, these sub-watersheds are facing numerous challenges, including soil erosion, landslides, deforestation, land degradation, and water pollution. To effectively manage and conserve these vital sub-watershed resources, here are some improvised recommendations for policy, plan, program, and strategy in watershed management:

1. Develop and Implement Comprehensive Sub-Watershed Management Plans: In order to solve the numerous sub-watershed problems project should develop and implement evidence-based comprehensive sub-watershed management plans that consider the various aspect such as biophysical conditions, environmental, economic, and social factors that affect watersheds. The plans should be based on sound scientific data and should involve all stakeholders in the process.

2. Institutional setup: The institutional setup for implementing watershed management activities at the district level is designed to involve all three levels of government: federal, provincial, and local. The following institutions are found suitable for the implementation of watershed management activities in the selected sub-watersheds.

i. Local Government Units: The local government units, including rural municipalities and municipalities, are responsible for the implementation of watershed management programs at the local level. They are also responsible for identifying the most suitable sites for the construction of small-scale water storage facilities, such as ponds, check dams and other small scale water and soil management infrastructures.

ii. Soil and Watershed Management Office (SWMO): The SWMO is responsible for implementing soil conservation and watershed management programs in the district. It provides technical assistance to the local government units and other stakeholders in the identification, planning, and implementation of these programs.

iii. Agriculture Knowledge Center (AKC): The AKC is responsible for implementing programs related to sustainable agriculture and land use practices at the district level. It also provides technical assistance to the local government units in the implementation of these programs.

iv. Water Resource and Irrigation Development Division Office (WRIDDO): The WRIDDO is responsible for the construction and maintenance of medium-scale water storage facilities, such as small dams and irrigation canals. It also provides technical assistance to the local government units in the identification and implementation of these programs.

v. Community-Based Organizations (CBOs): Various CBOs and user groups such as community forest user groups, water user groups, and farmer groups are also involved in the implementation of watershed management activities in the study area. The program should give emphasis on community-based watershed management by involving local communities in the planning and implementation of watershed management activities. This approach will ensure that local knowledge, skill, and expertise are integrated into the management of watersheds.

3. Tie up EIA with infrastructure development: In our context, tying up Environmental Impact Assessment (EIA) with infrastructure development in watershed management is crucial to ensure sustainable and environmentally conscious development practices. It helps in identifying and assessing the potential environmental impacts of infrastructure development projects in watersheds. It considers factors such as land use changes, soil erosion, water quality, biodiversity, and social impacts. It provides recommendations for mitigation measures and environmental safeguards to minimize and mitigate adverse impacts. This can include measures such as erosion control, afforestation, water conservation, and

proper waste management. By integrating EIA findings into infrastructure development plans, potential risks can be addressed proactively.

4. Capacity development and empowerment: Capacity building and empowerment play a crucial role in effective watershed management. They enhance the knowledge, skills, and participation of stakeholders, enabling them to actively contribute to sustainable watershed management practices. Some key aspects of capacity building and empowerment are knowledge and awareness raising, technical skills, stakeholder engagement, institutional strengthening, networking, and collaboration. These programs involve providing training, workshops, and educational programs to stakeholders, including local communities, government officials, and non-governmental organizations. By integrating capacity-building and empowerment strategies into watershed management initiatives, stakeholders can develop the necessary skills, knowledge, and empowerment to actively contribute to sustainable watershed management practices, resulting in improved water resource conservation, ecosystem health, and community resilience.

5. Encourage Reforestation and Forest Management: Local and provincial governments should encourage reforestation and community-based forest management activities in watersheds to prevent soil erosion and landslides, improve water quality, and increase water availability. This can be achieved through initiatives such as community forestry programs, leasehold forestry and public-private partnerships.

6. Promote Sustainable Agriculture Practices: Agriculture is a significant driver of deforestation and soil erosion in sub-watersheds. To address this issue, local governments should promote sustainable agriculture practices that reduce the use of agrochemicals and promote soil conservation practices.

7. Strengthen Monitoring and Evaluation of Watershed Management: Local and provincial governments should strengthen monitoring and evaluation of watershed management activities to assess the effectiveness of different policies, plans, programs, and strategies. This will enable policymakers to make informed decisions and adjust their approaches as needed.

1.7 Role and Responsibility

Recently, Nepal has transferred into a federal system and the constitution has given the roles, and responsibilities among three tiers of government for managing the natural resources, and climate change issues. Strengthening the Capacity of the federal, provincial, and local government agencies responsible for coordinating watershed management activities in the river basin, watershed, and sub-watershed level. Different agencies are involved to implement several programs aimed at improving their capacity to manage

watersheds, including capacity building for staff, development of policies and guidelines, and establishment of monitoring and evaluation systems.

In these contexts, the implementation of this Plan in the selected watershed requires the involvement and collaboration of various stakeholders. The key roles and responsibilities of different actors in the implementation process are as follows:

1. **Government Institutions:**

    i. Federal Level

- **Ministry of Forests and Environment, Singhdarwar, Kathmandu:** Provide policy direction, guidelines, and oversight to ensure the effective implementation of the CRIWMP.
- **Ministry of Agriculture and Livestock Development, Singhdarwar, Kathmandu:** Provide technical support and expertise in sustainable agriculture practices and livelihood diversification.
- **Ministry of Energy, Water Resource, and Irrigation, Singhdarwar, Kathmandu:** Providing policy guidance and strategic direction for the plan's implementation, allocating financial resources, addressing climate change impacts on water resources, coordinating with relevant stakeholders, and ensuring regulatory frameworks.
- **Department of Forests and Soil Conservation, Babarmahal, Kathmandu:** Lead the planning, preparing directives and guidelines, coordination, and monitoring of watershed management activities.

ii. Province level

- **Ministry of Tourism, Forests, and Environment, Koshi Province:** Providing strategic guidance, policy formulation, coordination, and support to local governments, community organizations, and relevant stakeholders in implementing the plan's objectives and activities. Incorporating climate change adaptation and mitigation measures into the province's forestry, watershed management, and environmental policies and programs. Additionally, it promotes capacity building, monitoring, and evaluation, ensuring the plan's progress is regularly assessed, and necessary adjustments are made based on lessons learned.
- **Ministry of Land Management, Agriculture and Cooperative, Koshi Province:** Promoting sustainable agricultural practices, resource allocation, supporting farmers in adopting climate-resilient techniques, and diversifying livelihood options. It facilitates capacity-building initiatives, knowledge exchange, and technical support to local governments, farmers' cooperatives, and other stakeholders to enhance their understanding and implementation of climate-responsive watershed management practices.

- **Ministry of Physical Infrastructure Development, Koshi Province:** Responsible for the planning, development, and management of physical infrastructure, including roads, bridges, irrigation systems, and other related facilities within the watershed area. It has key responsibilities of integrating climate change considerations, such as flood and landslide risk management, into infrastructure planning and design. Additionally, it also has a crucial role in providing technical expertise, overseeing construction activities, and ensuring the timely and quality implementation of infrastructure projects.

- **District-level institutions:**

Each of these province ministries has its Directorates and Divisional Offices for field-level implementation. The Basin Management Center (BMC), Divisional Forest Office (DFO), Soil and Watershed Management Office (SWMO), Water Resource and Irrigation Development (WRIDDO), Water Supply and Sanitation Division Office (WSSDO), Agriculture Knowledge Centers (AKC), Veterinary Hospital and Livestock Service Centers (VHLSEC), and Road Infrastructure Development Office (RIDO) are the main sectorial government organizations responsible to implement the annual plans and programs in the district level.

iii. Local level

- **Local Governments (Municipality and Rural Municipality):** Each municipality and Rural municipality has key responsibilities including the implementation of the plan, coordination, mobilization of resources, and engagement of local communities. It facilitates the establishment and strengthening of community-based organizations, such as soil conservation user groups, forest user groups, farmers' groups, water user groups, and farmers' cooperatives and associations, etc, and promotes their active involvement in decision-making and implementation. The local government also oversees the monitoring and evaluation of plan activities, providing feedback and making necessary adjustments to ensure the plan's effectiveness and sustainability. Additionally, it collaborates with relevant stakeholders, including government agencies, NGOs, and private sector actors, to foster partnerships and resource mobilization for successful plan implementation and achieving the desired outcomes.

2. Development Partners and Donor Agency:

3. Role and Responsibility of User Groups

- ❖ User groups typically consist of local residents, farmers, and other stakeholders directly affected by watershed activities. Their responsibilities include active participation in the planning, decision-making, and implementation processes of CRIWMP initiatives. User groups collaborate with government agencies, non-governmental organizations, and other relevant stakeholders to integrate climate-responsive practices into watershed management. They contribute local

knowledge and traditional practices, ensuring that the strategies adopted are culturally sensitive and contextually relevant. Additionally, user groups are responsible for the effective communication of climate-responsive techniques to the community, promoting awareness, and building consensus to achieve sustainable watershed management outcomes.

- The user groups are instrumental in implementing specific activities that enhance climate resilience within the watershed. These activities may include soil and water conservation measures, afforestation and reforestation efforts, adoption of climate-smart agricultural practices, and the development of community-based early warning systems.

- User groups are the custodians of natural resources, ensuring the judicious use of water, soil, and vegetation. They also facilitate the equitable distribution of benefits derived from watershed management initiatives among community members. Active involvement of local residents, user groups contribute to the long-term success of CRIWMP by fostering a sense of ownership, community empowerment, and adaptability to climate change challenges in the study area.

These actors need to collaborate closely, communicate effectively, and work in a coordinated manner to ensure the successful implementation of the CRIWMP in the selected watershed. This collective effort will contribute to building climate resilience, enhancing ecosystem services, and improving the well-being of the communities in the watershed area.

Chapter 2: Situation Analysis of Molung Rural Municipality

2.1 Molung Rural Municipality location

Molung Rural Municipality is located in Okhaldhunga district, Province 1 of Nepal. Molung Rural Municipality has total 8 ward distributed across 112 square kilometers of geographical area. The entire area of this Palika is within Molung watershed. It extends from 86° 20' 0" E to 86° 30' 00" E longitude and 27° 17' 52"N to 27° 26' 24" N latitude. It is surrounded by Siddhicharan Municipality in East, Khijidemba and Champadevi in West, Siddhicharan & Khijidemba in North, Sunkosi and Siddhicharan Municipality in South as shown in Figure 10.

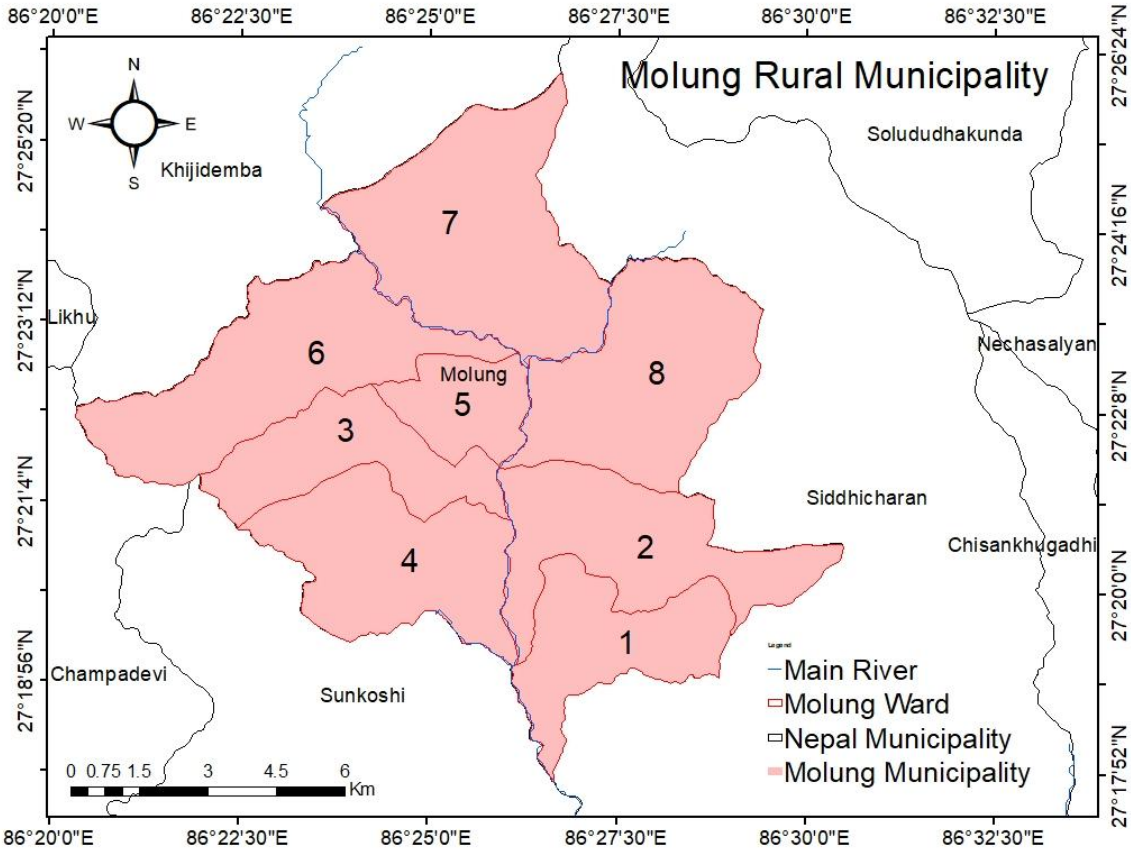

Figure 100: Location of Molung Rural Municipality

2.2 Molung RM Topography

The topography of Molung Rural Municipality extends from 650 m to 3016 m. Large area of Municipality fall within the topography between 1000- 1500 m and lower elevation along the river as shown in Table 2 and Figure 11(a).

Table 1: Distribution of topography by elevation in Molung RM

Topography/Area(km^2)	500-1000	1000-1500	1500-2000	2000-2500	>2500
Area(km^2)	8	35	30	29	10
Area (%)	7	31	27	26	9

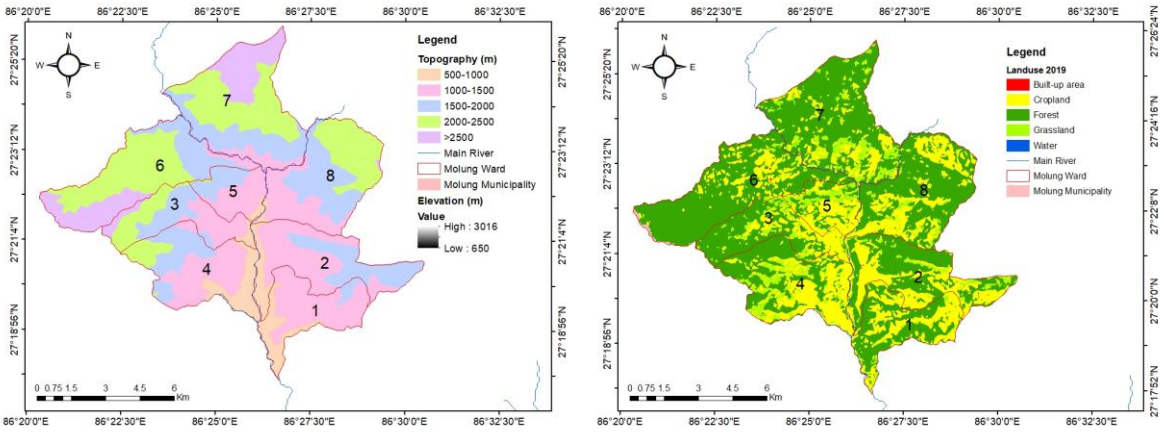

Figure 111: Left (a): Topography map; Right (b): Land use map of Molung RM

2.3 Molung RM Land use

Land use map has been extracted from data set of International Centre for Integrated Mountain Development (ICIMOD) 2019. About 29% of area is covered with agriculture land, 67% area covered with forest, 5% area with grassland, and 0.1% with built-up area as shown in Table 3 and Figure 11(b). Ward wise land use area has been included in Annex Table 2.1. Four decade of land use land cover has been analyzed for year 1990, 2000, 2010, and 2019 from the data set of ICIMOD. The pattern shows the decrease of agriculture land, with increase built-up area, grassland and forest. The detail land use cover of all decade is given in Annex Table 2.2 and figure is shown in Annex Figure 2.1.

Table 2: Land use of Molung Rural Municipality, 2019

LULC	Water	Forest	Built-up area	Cropland	Grassland
Area(km2)	0.1	75	0.1	32	5
Area (%)	0.1	67	0.1	29	5

2.4 Molung RM Soil type

As per record of National Soil Science Research Center (NSSRC), three types of soil found in the Molung Rural Municipality namely Gneiss/migmatite, Quartzite and slate/Phyllite. This palika is dominant of Quartzite soil by 43%, Gneiss/migmatite by 20%, Slate/phyllite by 26% shown in Table 4 and Figure 12(a).

Table 3: Type of soil and area covered of Molung RM

Soil Type	Gneiss, migmatite	Quartzite	slate, phyllite
Area(km^2)	36	48	29
Area (%)	32	43	26

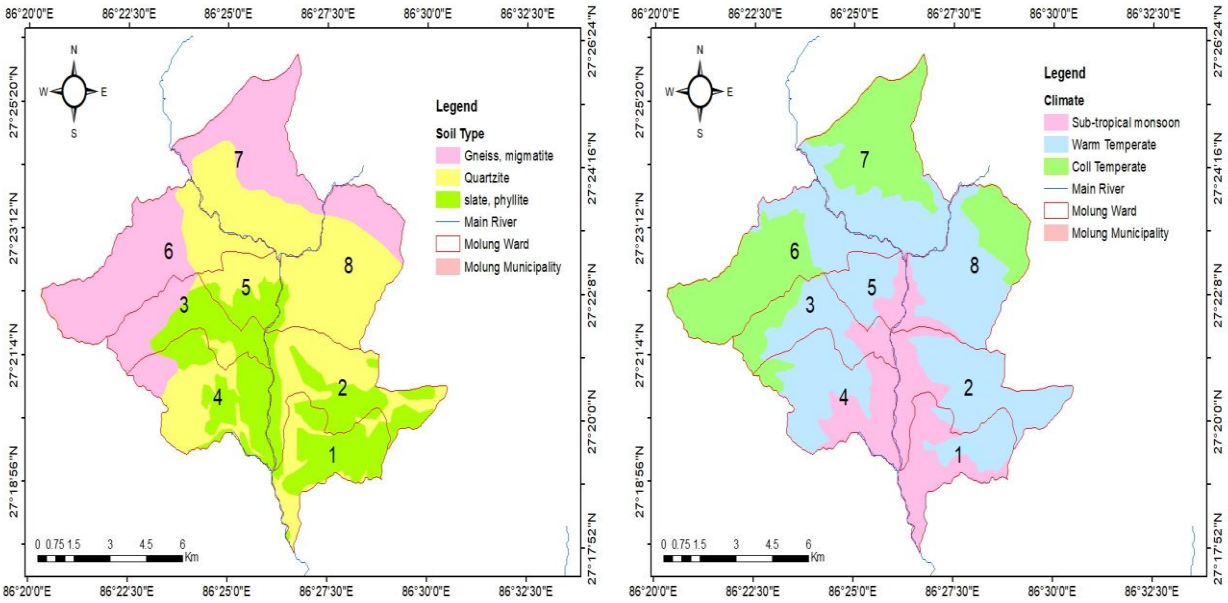

Figure 122: Left (a): Distribution of soil; Left (b): Climate distribution

2.5 Molung RM Climate situation

Nepal climate is divided into five types based on elevation namely sub-tropical Monsoon (sea level to 1200 m), Warm Temperate (1200-2100 m), cool temperate (2100-3350m), alpine (3350-5000m) and tundra (>5000 m) climate. In the Molung Rural Municipality, about 51% of Municipality come under Warm temperate climate, followed by Cool temperate (30%), sub-tropical monsoon temperate by 19% shown in Table 5 and Figure 12(b).

Table 4: Area occupied within different types of climate

Type	Sub-tropical monsoon	Warm Temperate	Cool Temperate
Area(km^2)	21	57	34
Area (%)	19	51	30

2.6 Molung RM River system and Sub-watershed

Molung Municipality is rich in water resource. Some main river of his Municipality are Molung River, Poting River, Kul River, Gaurabari River, Dole River, Jhagarpul River, Peku River, Selpi Stream, Chauyadi stream. The list of river and its feature for all ward is given in resource inventory summary Table and river network is shown in Figure 13(a).

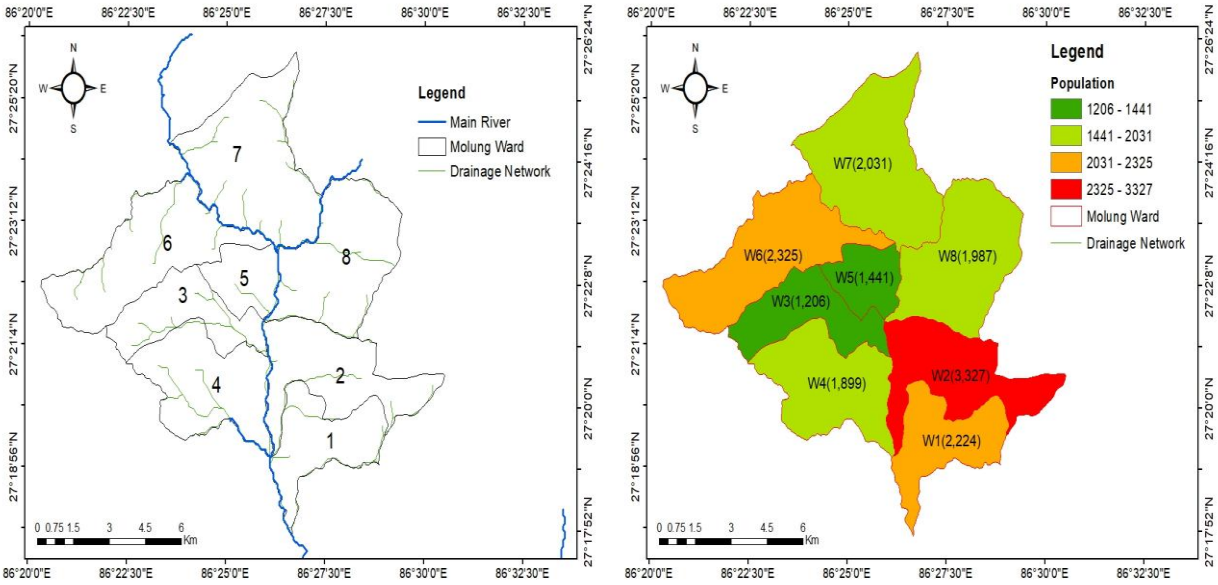

Figure 133: Left (a): River network; Right (b): Population distribution. Note: W represent ward and symbol "()" represent population as per 2021 census.

The sub basin of Molung Rural Municipality is approx. area of 10 km^2 to 23 km^2. Six sub basin fully fall under the Municipality, namely sub-basin 9, 10, 11, 13, 14, 15 and Six sub-basin cover some part within it namely sub-basin 5, 8, 6, 12, 16, 18 shown in Annex Table 3.1 and Annex Figure 3.1.

2.7 Molung RM Socio-economic profile and livelihood opportunities

According to 2021 Census conducted by Central Bureau of Statistics (CBS), Molung Rural Municipality had total population of 16,440 with male 8,027 and female 8,413 and population density is 146 per kilometer square. Total number of household is 4,069 with average household size is 4. The ward name, population number, density, household number size is for all ward is provided in Annex Table 1.1 and population range is shown in Figure 13(b).

The literacy rate of Molung RM is 73.8% of which 80.7% is Male and 67.4% is Female. Higher number of people have studied Education stream followed by Management, Humanity and Science technology. Percentage of school attendance is similar for male and female, however, only 73.2% student have regular attendance. 75.5% of population are economically active and 24.4% are not active. The statistic shows that, higher involvement of people in agriculture, forestry, fishery of which 72.8% are male and 80% are female.

2.8 Agricultural perspectives

Molung Rural Municipality has highly potential for agricultural crop production and livestock farming. Most of the area is having clay loam soil which is suitable to grow rice, maize, wheat, potato, millet, soya bean, pulses, horse gram, black gram, pigeon pea, vegetables and fruits like mango, banana, papaya, and all seasonal summer and winter fruits (Annex Table 6.1).

Rice, maize and wheat covers 75% and oilseeds cover 15% area of total cultivated agriculture land respectively. The main source of livelihood of more than 68.8% people is agriculture which is mainly at subsistence level. Majority of the farm population (53%) in Molung Rural Municipality are landless/near landless farmers who each hold less than 0.50 ha of land. The area is facing problem of poor irrigation facility, drought, soil productivity, marketing, technical human resources, ineffective institutional arrangement, lack of implementation of crop varieties and technology, increased diseases and pests in crop and animals. The cropping system of Molung Rural Municipality is given in Annex Table 6.2 and Annex Table 6.3. This municipality is behind for livestock production due to less forest area and grazing land grass and fodder species, dry climate and lack of irrigation. Major Livestock in Molung Rural Municipality are cattle, Buffalo, Sheep, Goat, Pigs, Fowl, duck which are generally for milk, eggs, wool and transportation purpose. There is lack of feed, improved breeds, easy access of vaccines and medicines for the treatment. (**Source:** Molung Rural Municipality Profile, 2075).

Food security is one of the main problem in Molung Municipality. Figure 14 shows food security situation in Molung Rural Municipality. In Molung municipality there are only 37(0.879%) households who have sufficient foods for year and rest do not have sufficient food and they have to buy foods for consumption. No of house hold who have food for 3-6 months and less than 3 months are more in numbers. The household who have enough food between 3-6 months and less than 3 months are 1689 (40.1%) and 1451 (34.48%.) respectively.

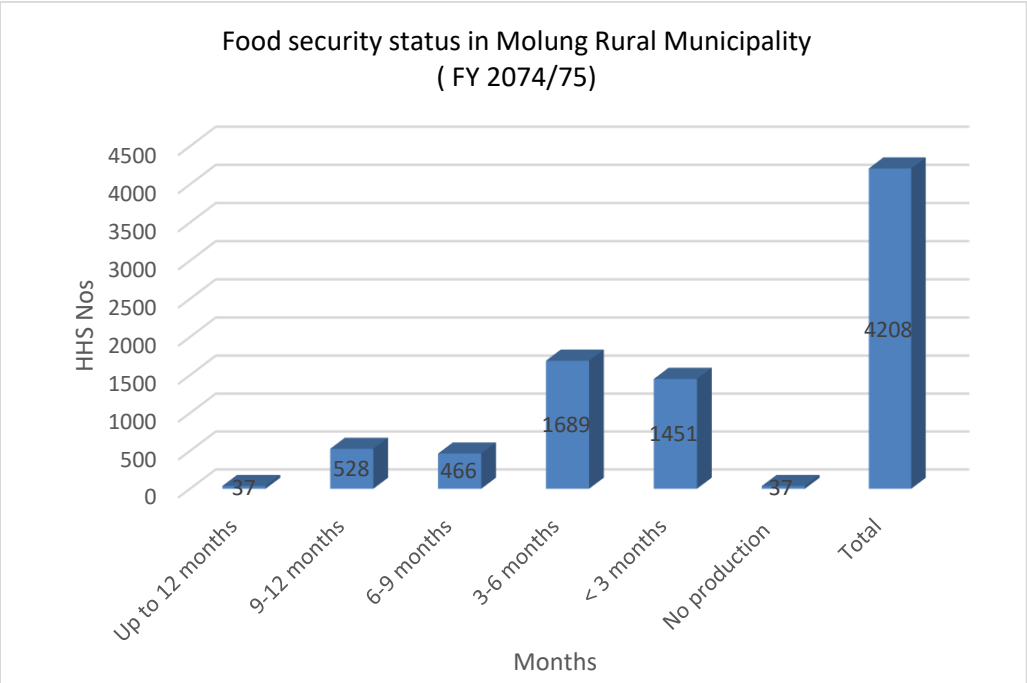

Figure 14: Food security Source: Molung Rural Municipality Profile 2075.

2.9 Market linkages mechanism

Market linkage means connecting farmers and producers more directly with markets. It's about connecting the end consumer all the way back to the source of production. Different types of marketing channels which are prevalent in the study area Direct selling to the consumers, Assembly markets, Wholesale markets, Retail markets, On-farm sales. Flow diagram of Marketing of agricultural products is shown in Figure 15.

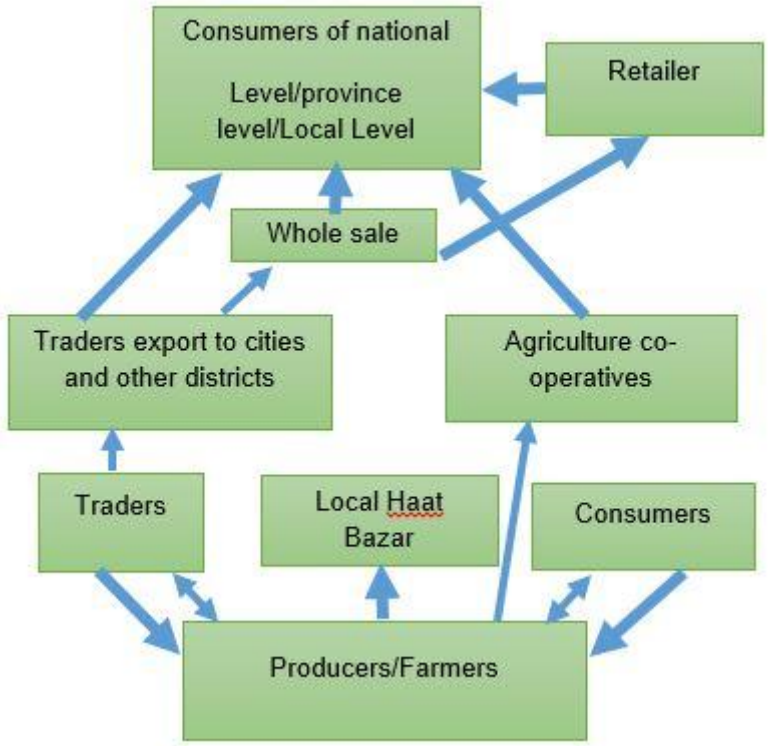

Figure 15: Flow diagram of Marketing of agricultural products

There are three haat bazzar at shree chour Mangalbare, Pracpcha and Patle in wards 8, 7 and 3 respectively. Main problems of marketing in the municipality are transportation, storage facilities such as rustic store, cold storage, predominance of intermediaries, lack of promotion activities, defective measuring equipment, lack of technical knowledge and organized market.

2.10 Water Stress situation

According to local residents and local government representatives, the majority of villages of these districts are severely water-stressed. Uses of dozers and excavators while constructing motorable roads are affecting water sources, and resources. According to community people, traditional ponds near settlements in Okhaldhunga and Khotang districts are drying up, with some collapsing as a result of infrastructure development, primarily motor roads. According the Hydrometeorological data of Department of Hydrology

and Meteorology (DHM); Okhaldhunga and Khotang districts shows that mean annual precipitation is less than the national average of 1,857.6mm, extreme rainfall in 24 hours is extremely high, and the annual precipitation trend is decreasing.

2.11 Status of irrigated agriculture

Some small irrigation project has been implemented and some are under construction by Government of Nepal (GoN) in collaboration with Government of Switzerland. About, seven small irrigation project has been implemented of total command area of 69 ha varying from 6 to 16 hectare providing benefits to about 455 households. Six small irrigation project are under construction of command area of total 42ha varying from 5 to 9 ha. The list of completed and ongoing small irrigation project with command area is given in Annex Table 4.2 and Annex table 4.3. Six irrigation project has been implemented from Department of Irrigation Nepal with net command area 204.6 Ha ranging from 13 ha to 66 ha area. The detail list of source, types, gross command area is given in Annex Table 4.1.

2.12 Impact of climate change in agriculture system and livelihood

There was an unexpected heavy rainfall in October 2021 badly affecting the lives of the people with huge loss of agricultural products. As a result, damage harvested rice in Chisankhugadhi RM. In this Municipality lumpy skin diseases (LSD) is a devastating disease of cattle and buffalo caused by a capripox virus was found in animal due to drought (AKC, Okhaldhunga, 2079; Field survey 2080). Degraded land has been increased due to climate change. As per previous study by DCRL, degraded land in chisankhugadhi Municipality was recorded as 755.8 ha and ward wise details of degraded land is shown in Annex Table 2.3.

2.13 Forest and status of drought resistant NTFP

Out of the total area of the Palika, about 67% (7500 ha) is covered by forest (ICMOD 2019). It encompasses a wide range of altitudes from 650 meters to 3,016 meters. Within this altitudinal gradient, it encompasses diverse forest types and species. At lower elevations, the forest types include tropical and subtropical broadleaf forests dominated by species such as Sal (*Shorea robusta*), Sissoo (*Dalbergia sissoo*), Simal (*Bombax ceiba*), Asna (*Terminalia tomentosa*), in mid hills, are Chir Pine (*Pinus roxburghii*), and Utis (*Alnus nepalensis*), Chestnut (*Castanopsis spp.*), and Chilaune (*Schima wallichii*). As the elevation increases, the forest types transition into temperate broadleaf forests characterized by species like Blue Pine (*Pinus wallichiana*), Oak (*Quercus semicarpifolia*), Walnut (*Juglans regia)*, Silver Fir (*Abies spectabilis*), Rhododendron (*Rhododendron spp.*), etc. These diverse forest types and associated species are an important ecological zone for a variety of non-timber forest products. NTFPs refer to the resources derived from forests other than timber, such as medicinal plants, herbs, fruits, nuts, fibers, and spices. Focus group discussion and key informants reported following drought-resistant NTFPs that are commonly found in drought-prone areas and climatic variability.

1. Medicinal and Aromatic plants: Species like*Taxsus bacata* (Lauth Salla)*, Artemisia indica* (Titepati), *Glutheria fragrantissima* (Dhasingre), *Swertia chiraita/Swertia augustifolia* (Chiraito)*, Bergenia ciliate* (Pashanvedh)*, Cinnamomum tamala* (Dalchini), *Rubia manjith* (Majitho), *Picrorhiza scrophulariiflora* (Kutki)*, Cinnamomum glaucescens (Sugandhakokila), Rheum australe and Rheum nobile* (Padamchal)*, Paris polyphylla* (Satuwa), *Tinosporasinensis* (Gurjo)*, Edgeworthia gardneri* (Argeli)*, Asparaggus resemosus* (Kurilo)*, Zanthozylum armatum* (Timur)*, Elettaria cardamomum* (cardamom)*, and Thysanolaena maxima* (Broom grass)*,*etc. Out of these Chiraito, Timur, Dalchini, Broom grass, and Kurilo have the potential for commercialcultivation on farmland, community forest, and leasehold forest. Provide budget, technical support, and subsidized seedling for commercial cultivation. Thereis potential to establish and promoteessential oil processing plants.

2. Edible fruits and nuts: Drought-resistant fruit trees like *Juglans regia*(walnut), *Pyrus pashia* (wild pear), *Phylanthus emblica* (Amala), *Aegle marmelos* (Bel), *Choerospondiasaxillaris* (Lapsi), and *Barberis aristata* (Chutro)are commonly found in a different part of the Palika. There ispotentialfor juice and pickle making from Bel, Lapsi, and Amala. Provide budget, technical support, and subsidized seedling for commercial cultivation on public and private farmland.

3. Fiber and handicraft plants: Species such as *Girardinia diversifolia* (Allo Himalayan nettle), *Urtica dioica*(stinging nettle), and *Bambusa spp*(Bans) are commonly used for making textiles, ropes, Nepali handmade paper,and handicrafts. Nettle are versatile NTFP species with multiple uses. Its fibers are used for making textiles, ropes, and baskets. Nettle leaves are also used in traditional medicine as a nutritious vegetable.Bamboo is a multipurpose species used for construction, furniture making, handicrafts, and as a raw material for various household products.These are some of the key NTFP species found in this municipality, offering economic opportunities, cultural values, and ecological benefits for the local communities.

The main problems facing (NTFPs), include limited access to markets and market information, inadequate infrastructure for collection, processing, and storage, lack of value addition and product diversification, and unsustainable harvesting practices. Insufficient market linkages and knowledge about market demands restrict the income potential for collectors and processors. The lack of proper infrastructure, including drying facilities, storage spaces, and processing units, affects the quality and marketing. Unsustainable harvesting practices, such as overharvesting and destructive collection methods, pose threats to the long-term availability and regeneration of NTFP species.In order to address these challenges, accessible forests are handed over to 28 CFUGs and 12 LHFUGs for community-based forest management practices at this local level (DOF Okhaldhunga, 2078). For promoting they provide budget, technical support, and

subsidized seedling for commercial cultivation. There is also the potentialfor establishing Allo based textile industry.

2.14 Indigenous knowledge

Indigenous practices provide invaluable knowledge and aid in making best use of natural resources. Some of the major indigenous technical knowledge applied.

- **Drying of harvested products:** Originally the traditional practice was that the maize cobs were kept dried by keeping them on the top floor where kitchen heat would facilitate drying of the seeds. They are also hanged outside forming a cluster called 'Suli' and 'Thangra'. Drying reduces the crop moisture content and susceptibility of the storage insect pest in grains.
- **Dusting of ash:** Ash is dusted to control aphids. It is also used to control ants in potato field. Application of ash repels insects and discourages surface feeding insects.
- **Ethnobotanical use of locally available plants:** Use of herbs like Neem, Bojho, Marigold, Titepati are used for the management of various pests depending on their local availability.
- **Field burning:** This method is performed to kill any insects or eggs of insects that may be present in the field. Field burning improves yield and reduce the requirement of pesticides and fertilizers. Slash and burn is still being practiced in different parts of Nepal including western mid hills of Nepal.
- **Foliar spray of cow urine:** Cow urine is sprayed over the plant as it acts as pest repellant. Cow urine, ash and soil mixture is useful for the treatment of cabbage plants. Cow urine is also used for the preparation locally made compost called 'Jhol Mol'. Nitrogen present in the urine also favors the development of the crops.
- **Irrigation:** Application of fresh irrigation water helps to control pest during outbreak. Drying and wetting of rice field for few days is also one of the indigenous practices followed by the farmers especially against case worm and leaf folder in rice. The grounded pulp of the 'Khirro' leaf is used in irrigation channel to control Rice stem borer.
- **Planting attractant/repellent crops on border of field:** Traps crops are used in the borders as attractants and repellents to protect the main crop field from insect pests. Mustard crops are planted on border of wheat field and coriander on border of Cole crop to attract the crop away from the major field. Marigold plants are also used as trap crop in many vegetable and cereal crops.
- **Ploughing:** Ploughing with traditional plough called 'Halo' is performed before plantation to remove the weeds and killing of eggs of insect.
- **Preparation of indigenous pesticide:** Indigenous pesticide is prepared using cow urine and jaggery. The toxicity of the mixture kills the insects and pests that come in contact with it.

- **Storage in bamboo container**
- **Use of scare crow to scare birds and animals**

2.15 Status of wetland and its conservation

Field level consultation and resource surveys found seven wetlands, including ponds and marshes. These are important for biodiversity conservation, water resource management, flood control, and supporting local livelihoods. These some wetlands inclue Dhamal, Simpani, Dunde Simle, Jaljal, and Sepli etc which are adversely affected by drought, siltation, catchment areas degradation. Status of wetlands in this Palika is given in Annex Table 2.3. Conservation of these wetlands is essential for maintaining ecological balance, water resources, and biodiversity. Wetland restoration, water management, promotion of ecotourism, sustainable land use practices on catchment area, and stakeholder engagement in planning and management are the major recommended wetland conservation activities. Some site-specific activities to restore the wetlands include excavation, stone masonry on the periphery, and inlet-outlet maintenance and irrigation canal improvement for efficient water use. Similarly, other activities include terracing, contour bunding, broom grass planting, and native species plantation within its catchment area. In order to retain the water body, promote the management of runoff for feeding, rainwater harvesting, contour trenching, etc. Encourage farmers to minimize the use of chemical fertilizers and pesticides and promote organic farming and planting of native species.

2.16 Risk Analysis

1. Flood Risk

This palika is affected with flood during monsoon season, the flood impact has been observed in settlement area, agriculture land, and the area near the river bank. The recommended mitigation measure are afforestation, retaining wall structure, river training, reduce river encroachment. The detail about the river condition and preventive measure for each ward is given in resource inventory.

Flood risk has been studied after detail analysis from survey data and field verification. It is estimated that about 1.01 km^2, 0.45 km^2, 0.32 Km^2 areas in Molung are under high, moderate and low flood risk zone respectively. The decreasing order of flood risk ward: Ward 4>ward 7>ward 2 & ward 8>ward 3 & ward 5>ward 1> ward 6. Table 6 show flood risk across ward of Molung Rural Municipality and flood risk map is shown in Figure 16.

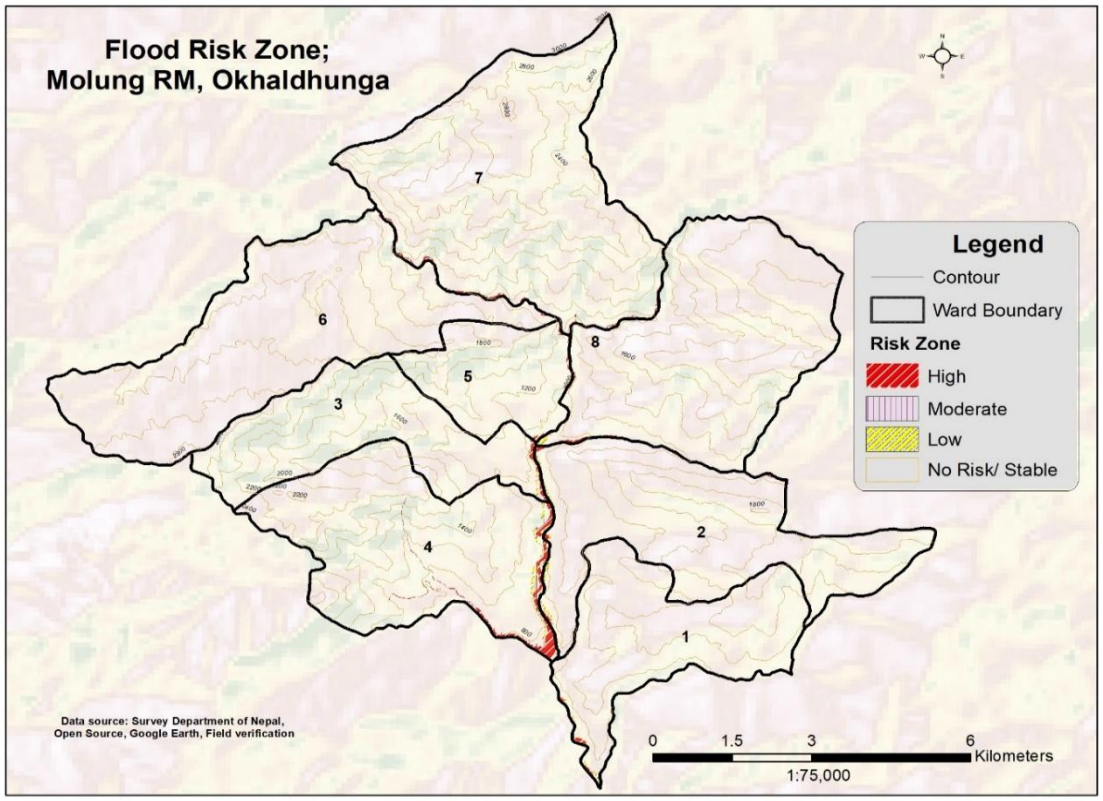

Figure 16: Flood risk map

Table 5: High, medium and low flood risk zone

Risk Level	1	2	3	4	5	6	7	8	Grand Total (km^2)
High	0.06	0.09	0.07	0.43	0.07	0.04	0.15	0.09	1.01
Low	0.06	0.09	0.02	0.12	0			0.02	0.32
Medium	0.04	0.05	0.04	0.26	0.02		0	0.04	0.45
Grand Total	0.16	0.23	0.14	0.81	0.09	0.04	0.15	0.15	1.77

2. Drought

The drought result of Molung RM has been collected from previous study of DCRL (2018) and has been processed at ward basis. Ward 2 show exceptional drought frequency of 2.1%, ward 8 of 1.1 % and remaining ward shows 0.5%.

3. Landslide risk

Nepal Disaster Risk Reduction Portal, 2023 shows about nine number of landslide has been occurred affecting human life and property Annex Table 5.1. Primary field survey, show about 27 number of landslide has been occurred in this Palika affecting agriculture land, human settlement and also impacting road. The recommended preventive measure are afforestation, gabion wire, proper management of drainage flow, slope stabilization, debris flow management, retaining wall.

Landslide risk has been studied after detail analysis from survey data and field verification. It is estimated that about 26.56 km^2, 68.79 km^2, 15.16 Km^2 areas in Molung are under high, moderate and low Landslide risk zone respectively. The decreasing order of landslide risk ward: Ward 4>ward 7>ward 2 & ward 8>ward 3 & ward 5>ward 1> ward 6. Table 7 show landslide risk across ward of Molung Rural Municipality and landslide risk map is shown in Figure 17.

Table 6: High, moderate and low landslide risk zone

Risk Level	1	2	3	4	5	6	7	8	Grand Total (km^2)
High	3.16	2.93	0.98	1.58	1.08	2.34	11.13	3.35	26.56
Low	1.84	4.15	0.93	2.48	0.94	1.26	0.50	3.07	15.16
Moderate	5.41	7.23	7.79	10.06	3.55	14.69	9.23	10.83	68.79
Grand Total	10.41	14.30	9.71	14.12	5.57	18.29	20.85	17.25	110.51

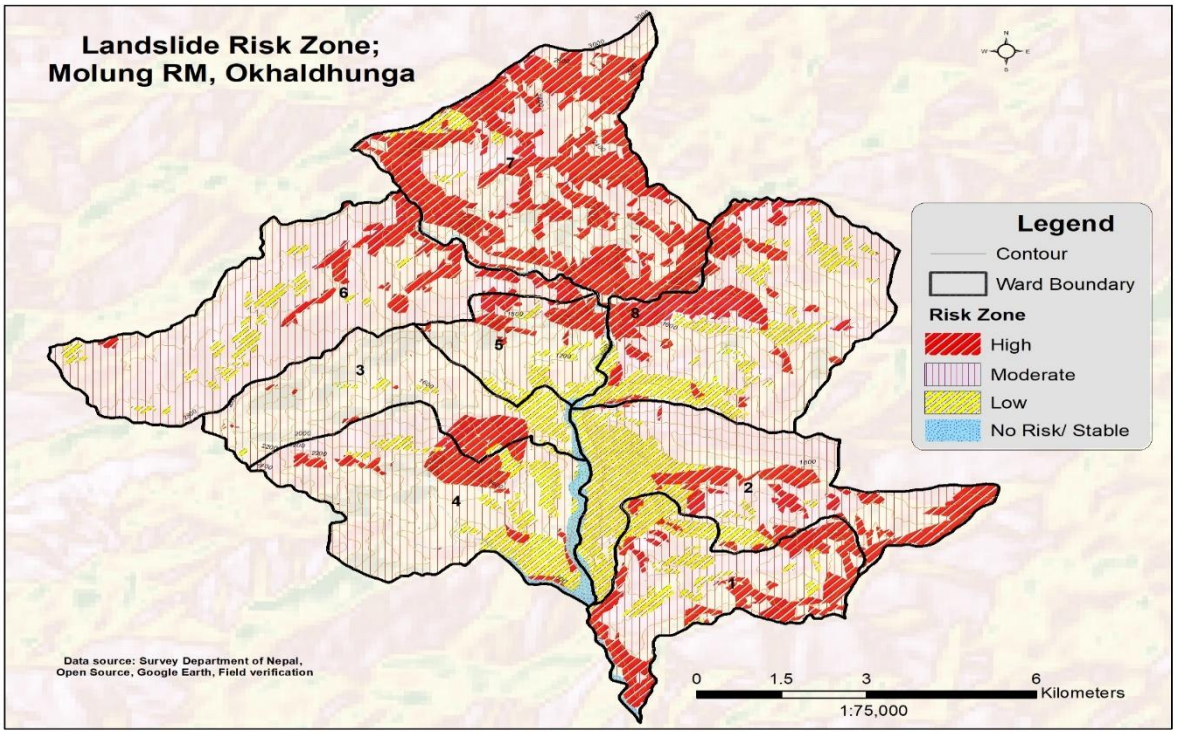

Figure17: Landslide risk map

4. Fire risk

The fire record has been extracted from Nepal Disaster Risk Reduction Portal. 17 times fire incidence has been reported from 2017 to 2023.

Fire risk has been studied after detail analysis from survey data and field verification. It is estimated that about 8.76 km^2, 13.3 km^2, 20.26 Km^2 areas in Molung are under high, moderate and low fire risk zone respectively. The decreasing order of fire risk ward: Ward 2>ward 6>ward 4>ward 1>ward 8>ward 7>ward 5>ward 3. Table 8 show fire risk across ward of Molung Rural Municipality and fire risk map is shown in Figure 18.

Table 7: High, moderate and low fire risk zone

Fire risk/ward no.	1	2	3	4	5	6	7	8	Grand Total (km^2)
High	0.90	4.03	0.11	0.92	0.21	1.02	0.75	0.82	8.76
Low	0.77	2.53	2.66	3.15	0.01	6.27	3.50	1.37	20.26
Moderate	2.18	1.17	1.25	2.01		0.90	2.95	2.85	13.30
Stable	6.72	6.81	5.82	8.85	5.44	10.15	13.80	12.36	69.95
Grand Total	10.57	14.54	9.84	14.93	5.67	18.33	21.00	17.40	112.28

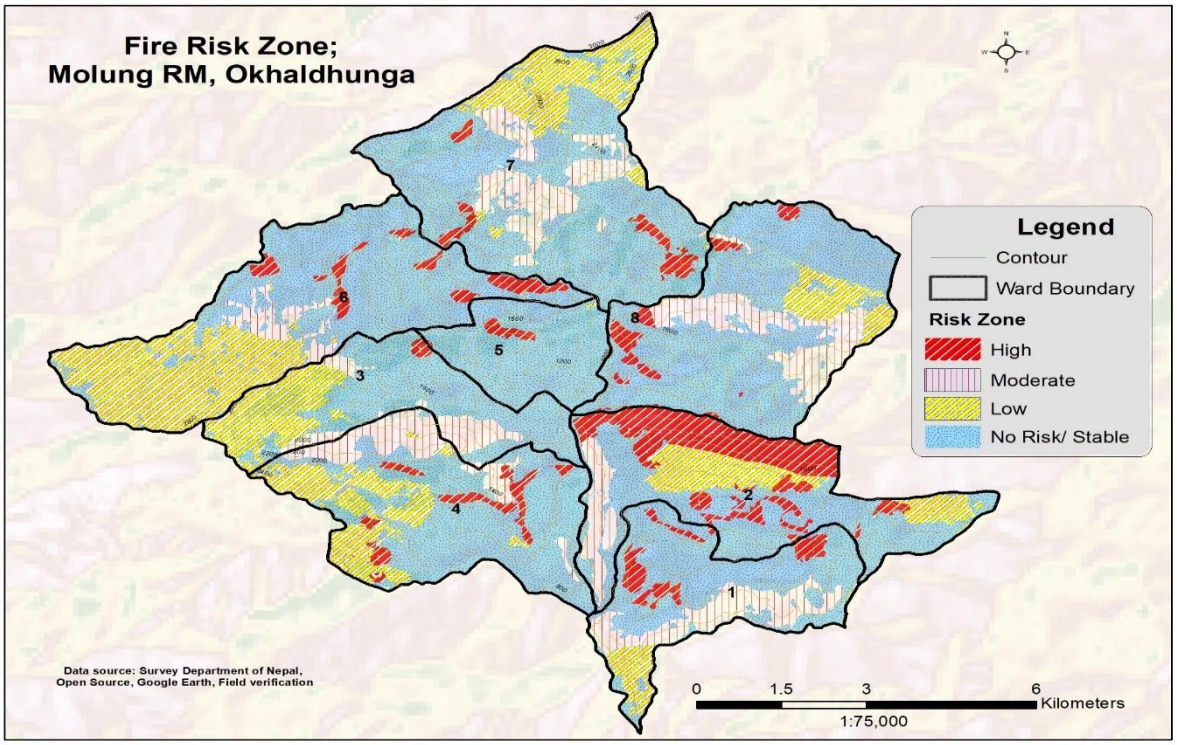

Figure 17: Fire risk map

5. Soil Risk

Soil erosion has a significant impact on water resources, agriculture, forest, built-up area in various ways. It can disrupt the delicate balance of ecosystems, impair water quality, reduce water availability, loss of top soil deceasing agriculture yield and forest degradation and lead to other ecological and economic problems.

Soil erosion risk has been studied after detail analysis from survey data and field verification. It is estimated that about 9.89 km^2, 53.14 km^2, 47.48 Km^2 areas in Molung are under high, moderate, low soil erosion risk zone respectively. The decreasing order of soil erosion risk ward: Ward 4>ward 8>ward 7>ward 3>ward 6>ward 5>ward 2>ward 1. Table 9 show soil erosion risk across ward of Molung Rural Municipality and map is shown in Figure 19.

Table 8: High, moderate and low soil erosion zone

Risk Level	1	2	3	4	5	6	7	8	Grand Total (Km^2)
High	0.04	0.29	1.52	2.52	0.43	0.79	2.06	2.24	9.89
Low	3.92	11.01	2.38	8.41	2.25	4.13	8.56	6.83	47.48
Moderate	6.45	3.01	5.81	3.19	2.89	13.37	10.23	8.19	53.14
Grand Total	10.41	14.30	9.71	14.12	5.57	18.29	20.85	17.25	110.51

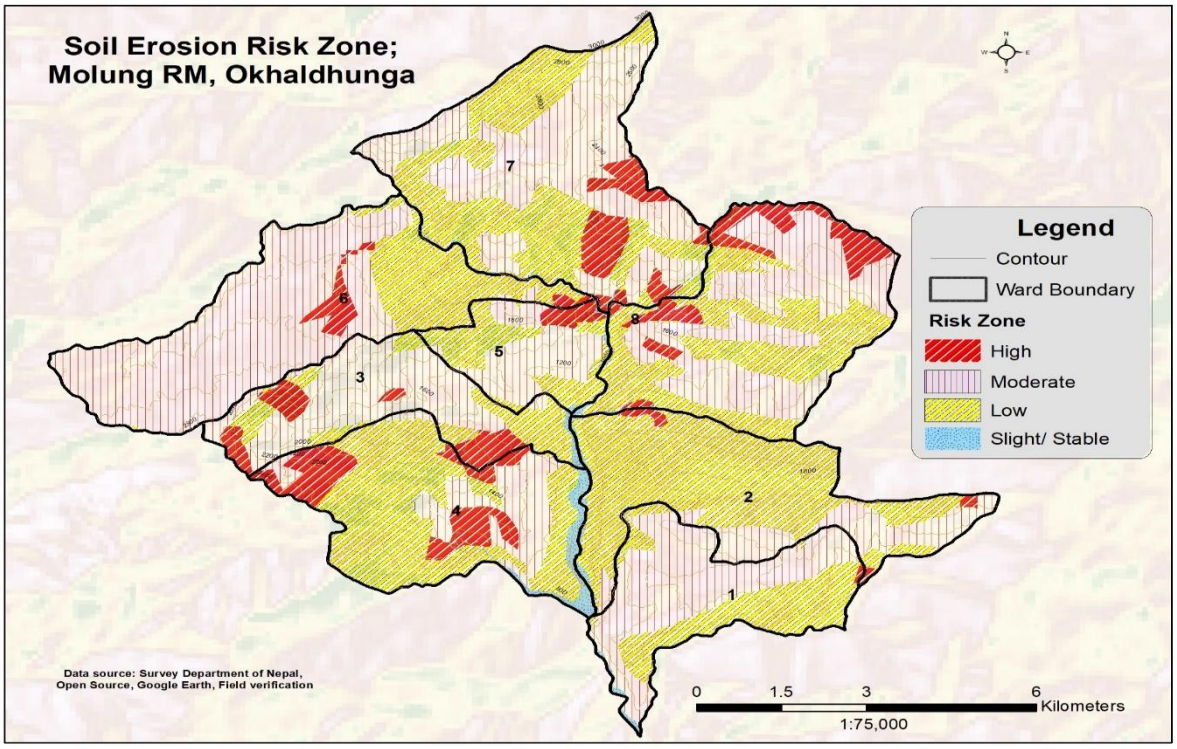

Figure19: Soil erosion risk map

2.17 Gender Equality and Social Inclusion

The sustainable utilization and management of water resources can only be achieved by addressing various dimensions of water governance. Achieving gender and social inclusion (GESI) is an important aspect of water governance to ensure each section of society have equal access to water as well as in the management of the water resources.

This study endeavors to assess the current GESI scenario, identifying associated problems and opportunities. The methodology involves a comprehensive review of all local government profiles (palika), along with the implementation of Key Informant Interviews and analysis of the Central Bureau of Statistics (CBS) database.

The study shows increase in awareness regarding Gender Equality and Social Inclusion (GESI), despite encountering some challenges. Examining education, the literacy rate is 80.7% for males and 67.4% for females. While there has been an improvement in female literacy, the numbers for higher education still indicate a lower representation compared to males. Additionally, marginalized groups face a disparity in education, primarily because of economic factors, household responsibilities.

When it comes to economic activity, approximately 56.5% of females and 65.5% of males are actively engaged (CBS, 2021). The statistics indicate a significant presence in the sectors of agriculture, forestry, and fishery, with 72.8% of males and 80% of females involved in these areas. Notably, agriculture emerges as a more substantial source of economic activity for females compared to males. Inactive Female in economic activities, primarily due to

household responsibilities and males may be less involved in economic activities due to pursuing education or handling household chores.

Regarding involvement in social and development activities, there are some initiatives focusing on training, awareness, and community participation. Various user groups like women group, drinking water user, irrigation user groups and community forest user group organize training and awareness programme. The community forest user groups seem to be very inclusive because there is mandatory provision to include women in key post either in chairperson or secretary. There is special emphasis on programme addressing drinking water and sanitation as well as promoting gender equality. However, still various women and individuals from diverse groups still face challenges in actively participating and realizing the benefits of these training programs. This is often due to their existing work responsibilities, a limited appreciation of the programs, lack of suitable mechanisms to involve a wide range of individuals.

To enhance inclusivity and equity, there is need to formulate comprehensive Gender Equality and Social Inclusion (GESI) plans and policies. A sets of GESI related activities are included in capacity development and institutional development component. The recommended activities are gender mainstreaming training and leadership development programs. Furthermore, there is a necessity to involve capacity development training and income generation activities, targeting women and marginalized groups.

2.18 Summary on the resources within Palika

The team of expert did analysis based on the FGD, KII done by enumerators and district level consultation by experts. The ward wise issues, general information, causes, impact on resources and potential preventive measures are summarized in tabular form in different sector like water resources, landslide, forest and bio-diversity, road in Table 10.

Table 9: Resource summary considering general context, problem, cause and preventive measure.

Ward 1	General Information	Key problem/ Causes	Preventive measure
Water Resource	• 1 spring sources, used for drinking water providing services to about 400 households.	• All the sources are not in uses due to lack of investigation of sources	• Need to find the all sources and make them usable.
Land use/ agriculture	• 3 crops a year. • The major crops are Maize, Paddy, potato, mustard and Wheat.	• Productivity decreased in last five years due to climate change and foreign employment. • Wild animal destroy the agricultural product.	• Knowledge of modern agriculture technology. • Control of wild animal. • Construction of irrigation canal.
River/ Flooding	• 2 main rivers called: Chorey khola and dhobi khola which all are Medium River.	• During Monsoon season, these river affects agriculture land and all caste people.	• Afforestation, river training, wire fencing
Forest	• 5 important community forests called: Dungi bilami, dadakhraka, jhagarpur, kuntadevi, and thapachaur • Types of trees found are salla, uttis, kutmera. • Medicinal herb found: Amala, tej patta,nims patta	• All the medicinal herbs are not in use due to lack of investigation.	• Investigation of medicinal herbs. • Establishment of small industry.
Landslide	• 1 landslides occurs in 2052 BS.	• Disturb road every year	• Gabion work, Afforestation, Debris flow management • Construction of drainage. •
Road	• 3 main road in normal condition. • All roads are alluvial.	• Impact on forest, agriculture productivity, and landslides.	• Proper study while setting alignment of roads. • Retaining wall, wire fencing.
Ward 2	• **General information**	• **Key problem/ Causes**	• **Preventive measure**
Water Resource	• 8 spring sources, used for drinking, cleaning of animal and various purposes, providing services to about 995 households.	• Sources are unmanaged and pipes are less effective for sufficient supply of water.	• Conservation of source, Afforestation. • Maintenance of sources and managed of pipes.
Land use/agriculture	• 2 and 3 crops per year. • The major crops are paddy, maize, millet, mustard, potato, Buckwheat etc.	• Productivity decrease in last five years due to wildlife attack, lack of irrigation, unmanaged canal.	• Control of wild animals. • Construction of irrigation canal and management of canal.
River/Flooding	• 5 Main river of small and large size. • The rivers are: Molung, Poking, jhagarpur, pahirey and lipey.	• Affected on agricultural land, forest, road, irrigation structure.	• Construction of retaining wall, wire fencing. • Construction of bridge and embankment.

		• Brahamin, khas arya, and other caste people are affected by flooding.	
Forest	• 4 important community forest: Mahabhir hariyali, Raniban, Tekanpur and tilkhoriya ban. • The main trees found are: salla, saal, guras, mauwa, uttis, chilaune, paltle. • Medicinal herbs found are: amala, kurilo, pakhande etc.	• Forest are decrease day by day due to deforestation. • All the trees and medicinal herbs are not in use due to lack of investigation.	• Control of deforestation. • Establishment of small industry for product of medicinal herbs.
Landslide	• 3 landslides occurs in 2045, 2078 BS.	• Sustained damage. • Affected on human settlement and road	• Afforestation and gabion wire. • Construction of motorable bridge. • Construction of masonary wall.
Road	• 12 regionals, local and other road. • Some are DVST and many are alluvial roads.	• Road are in fragile condition. • Difficult to travel in rainy seasons and many accident take place.	• Upgrade the road in gravel and bitumen types. • Construction of motorable bridge and drainage along the road.
Ward 3	• **General information**	• **Key Problem/cause**	• **Preventive measure**
Water Resource	• 5 rivers sources, used for drinking water providing services to about 380 households.	• Sources are polluted which causes diseases to local people. • Pipes are in unmanaged condition.	• Conservation of drinking water source by wire fencing and maintenance • Polluted water should make clean before supply to local peoples. • Pipes should be well managed for easily supply of water.
Land use/agriculture	• 1 2 and 3 crop per year. • Major crops are: Maize, wheat, potato, millet, mustard and unseasonal vegetables.	• Productivity decreased in last five years due to climate change and lack of irrigation.	• Uses of Modern irrigation technology. • Irrigation canal management
River/Flooding	• 3 main rivers called: Prapcha khola, kulkhola, khalte khola. • River are small types.	• Affected on sunuwar, khas arya caste.	• Gabion work and retaining wall.
Forest	• 2 important community forests called: Aaitabare ban and kabuliyati ban. • Types of tree found are: sallo, chilaune, uttis	• All trees are in not in uses.	• Study and find the suitable uses of available trees.
Landslide	• 2 landslides occur in 2072 and 2079 BS.	• Affected in human settlement, road and other infrastructure every year.	• Afforestation and retaining wall. • Settlement changes from risky area. •

Road	• 4 local and regional roads. • All roads are alluvial.	• Roads are narrow and slippery which cause accident. • Lack of drainage along the roads.	• Road should be upgrade to gravel and bitumen. • Widening of roads and construction of drainage. • Afforestation along the roads side.
Ward 4	• **General information**	• **Key problem/cause**	• **Preventive measure**
Water Resource	• 6 stream sources, mostly used for drinking water, providing services to about 660 households.	• Lack of managed sources for supply of water. • Pipes are in unmanaged condition.	• Construction of sources. • Pipes management.
Land use/agriculture	• 2 and 3 crop per year. • The major crops are: Maize, mustard, potato Paddy, wheat etc.	• However, productivity decreased in last five years due to lack of irrigation and lack of chemical fertilizers and pesticides	• Sufficient irrigation. • Timely available of chemical fertilizers and pesticides.
River/Flooding	• 2 main rivers: Gattekhola and Molung kul khola. • Both rivers are seasonal river.	• Affected on human settlement of magar, Gurung, tamang, darji caste people.	• Afforestation, masonry wall construction. • Construction of embankment.
Forest	• 4 important community forests called: dadapahira bhalumar, saalghari kulghari, saalghari thulibhir, saakghari guthipathal. • Types of trees found are sallo, saal, chilauni. • Medicinal herbs are: Pakhanbed, titepati, Hattichur.	• All the medicinal herbs that are found are not in use due to lack of investigation.	• Use modern technology for maximum use of medicinal herbs.
Landslide	• 5 landslides occur yearly.	• Affected on water supply, human settlement, irrigation, and road.	• Afforestation, construction retaining structure. • Construction of masonry wall and embankment.
Road	• 5 main road in which all are alluvial.	• Impact on agriculture, forest, houses, and other infrastructure due to landslides.	• Afforestation, retaining structure. • Gabion wire, drainage management.
Ward 5	• **General information**	• **Key problem/cause**	• **Preventive measure**
Water Resource	• 5 streams sources, mostly used for drinking water, providing services to about 500 households.	• Unmanaged water delivered system and reserve tank.	• Construction of intake and reserve tank. • Sources, pipelines and tap construction.
Land use/agriculture	• 2 and 3 crop per year. • The major crops are: Maize, rice, wheat potato, fapar, mustard etc.	• However, productivity decreased in last five years due to foreign employment, migration and climate change.	• Timely availability of fertilizer and seeds. • Management of canal and river control. • Modern technology for agriculture, irrigation and wildlife control.

River/Flooding	• 1 main river: Molung khola • River encroachment in 2012 and 2058 BS	• Affected on 3 Km agricultural land. • Khas arya people are affected.	• Change the direction of flow, Gabion wire, and afforestation.
Forest	• 6 important community forests called: Khoparkhola ban, Dadeguras ban, aaitabarey ban, Gabga jamuna ban, janajagaran ban • Types of trees found are okhar, chilaune, salla etc. • Medicinal herb like bojo, tulsi etc.	• All the trees and medicinal herbs are not in use due to lack of investigation.	• Conservation of forest and medicinal herbs. • Investigation is necessary for finding all types of medicines.
Landslide	• 2 landslide on 2058 and 2079 BS.	• Destruction on human and human settlement. • Yearly impact on agriculture and road.	• Afforestation, retaining structure, gabion wire. • Construction of embankment.
Road	• No information.	• --	• --
Ward 6	• **General information / Causes**	• **Key problem/cause**	• **Preventive measure**
Water Resource	• 16 stream sources, mostly used for drinking purpose, providing services to about 1140 households.	• Necessary for maintenance of sources. • Pipes are unmanaged.	• Improvement in sources of water. • Pipes should be managed.
Land use/agriculture	• 1 2 and 3 crop per year. • The major crops are: Maize potato, wheat, potato, millet, buckwheat, cotton, chilly, etc.	• However, productivity decreased in last five years due to wildlife attack, lack of irrigation, foreign unemployment etc.. • Lack of soil test and quality seeds.	• Sufficient irrigation, Availability of fertilizer and seeds, Reduction of wildlife attacks. • Better employment opportunity • Modern technology for agriculture.
River/Flooding	• 6 main river: Patkhari khola, ghumauni khola, seleley khola, mangalbare, amiley and kholi khola.	• Affected on tamang, serpa caste people.	• Change the direction of flow, fencing and afforestation.
Forest	• 3 important community forests called: Tintaley ramailo ban,jalpadevi ban,Namuna tintaley ban. • Types of trees found are laliguras, salla, ageli machino etc. • medicinal herb like machino, saduwa, chirailo, titepati etc.	• Need to conservation of forest.	• To conduct awareness program about important of forest.
Landslide	• 4 landslides occurs on 2072 2075 2079 BS and 2070BS.	• • Destruction all infrastructure every year.	• Afforestation, retaining structure. • Canal management.

Road	• 8 local and regional roads. • All roads are alluvial.	• Impact on agriculture land, houses, water supply, forest. • Difficult to travel in rainy seasons.	• Afforestation, retaining structure. • Need to black top roads.
Ward 7	• **General information**	• **Key problem/cause**	• **Preventive measure**
Water Resource	• 15 streams sources, mostly used for drinking water, providing services to about 550 households.	• Polluted source. • Pipes unmanaged.	• Improvement in sources structure and make clean. • Management of pipes.
Land use/agriculture	• 1 crop per year. • The major crops are: Maize potato, millet, wheat etc.	• However, productivity decreased in last five years due to wildlife attack, foreign employment, and low productivity.	• Sufficient irrigation, Availability of fertilizer and seeds, Reduction of wildlife attacks. • Irrigation canal construction and maintenance. • Using modern technology for high product with less manpower.
River/Flooding	• 4 main river: Ghattekhola, chagekhola, bakhrekhola, khanikhola, and lapsekhola. • Some are small, medium and large river,	• Soil cutting, • Effect on land, forest, road and other infrastructure. .	• Wire mesh, RCC, fencing and afforestation. • Construction of masonry wall.
Forest	• 4 important community forests called: panchakanya, Raniban, Serogari and tinjuli ban. • Types of trees are utis, guras, chilaune, salla, katus etc. • Medicinal herb like Pakhanbed,thulo okhati, argali, satuwa chiraito, etc.	• Need to conservation of forest. • Furniture industry is not in effective uses.	• To conduct awareness program about important of forest • Effective uses of furniture industry.
Landslide	• 7 landslides of different sizes in different times.	• • Destruction land, infrastructure, houses, road every year.	• Afforestation, gabion works.
Road	• 8 main roads .All are alluvial.	• Effect on land, forest, houses water supply.	• Construction of retaining wall, afforestation etc.
Ward 8	• **General information**	• **Key problem/cause**	• **Preventive measure**
Water Resource	• 6 spring sources, mostly used for drinking water and, irrigation, providing services to about 695 households.	• Polluted sources. • Pipe unmanaged.	• Maintenance and cleaning of sources. • Management of sources
Land use/agriculture	• 2 crop per year. • The major crops are: Maize potato, paddy ,millet wheat mustard buckwheat etc.	• However, productivity decreased in last five years due to climate change, insufficient fertilizers.	• Sufficient irrigation, Availability of fertilizer and seeds, Reduction of wildlife attacks.

		• Low productivity.	• Testing of soil and use suitable soil for suitable seeds
River/Flooding	• 3 main rivers: Seple, Molung pothdhing, and sirse bagde.	• Affected on 180 HHS.	• Wire mesh, fencing and grouting. • Construction of gabion wire • Retaining wall.
Forest	• 7 important community forest called: Mahabhir, bhirpakha, lumlo, sunakhari, bagdip, raniban and sakhare. • Types of trees found are sallo, uttis, katus, chilaune, saal,etc. • Medicinal herb like machino, satuwa, amala, titepati etc.	• Need to conservation of forest. • All available medicinal herbs are not in use.	• To conduct awareness program about important of forest and medicinal herbs. • Establishment of medicine product center.
Landslide	• 6 landslides occurs on 2033, 2075 and 2079BS.others are yearly.	• Affected on land, water supply, settlement and forest. • Road are disturb by landslides yearly.	• Afforestation, gabion works. • Construction of retaining wall.
Road	• 12 local and regional roads in which all are alluvial. • Present condition of roads are fragile.	• Affected on agriculture, houses and forest due to cutting.	• Retaining wall construction. • Afforestation, drainage construction.

Chapter 3: Climate responsive integrated watershed management plan

3.1 Vision, Goal, Thematic area

3.1.1 Vision, Goal, objective, guiding principle

Climate responsive integrated watershed management plan (CRIWMP) is a comprehensive strategy designed to address the problems of managing watershed resources within a specific watershed in the context of climate change. It gives emphasis to build resilience, adapt to climate change, and promote sustainable development for the benefit of both present and future generations. The vision of the CRIWMP is to ensure the sustainable management of watershed resources, enhance ecosystem resilience, and improve the livelihoods and well-being of communities within the vulnerable watershed in the face of changing climatic condition. The goal of the CRIWPM is to develop and implement strategies that effectively address the impacts of climate change on water resources, ecosystems, and communities within the vulnerable watershed. The ultimate aim is to achieve a balanced and equitable use of water, promote ecosystem health, and enhance the resilience capacity of the watershed to climate change. The main objective of the CR-IWMP is to analyses problem, baseline data, formulation of practical coping strategies for watershed planning and interventions for preparing climate resilient livelihood at both watershed and government unit level i.e. Palika level.

The guiding principles of this plan will be based on the set of values and considerations that will guide the decision-making and implementation process. These principles were followed to formulate the plan which is comprehensive, equitable, adaptive, and sustainable plan. Some key guiding principles of the plan are integrated approach of watershed planning; climate resilience: ecosystem-based approach; community participation and ownership, gender equity and social inclusion, knowledge and capacity building; cross-sectoral collaboration.

3.1.2 Rational of the CRIWMP

Molung watershed has the most fragile ecosystems characterized by steep slopes, fragile geology, poor agricultural potential, and water scarce area. The rationale behind a climate responsive integrated watershed management plan preparation is also rooted in the need to address the complex challenges posed by climate change, upstream and downstream problems and ensure sustainable watershed resource management. Here are some key reasons that justify the development and implementation of such a plan:

1. Vulnerability to Climate Change: These two watersheds are highly vulnerable due to the impacts of climate change due to its unique geographical and topographical characteristics. This area is prone to a range of climate-related hazards, including floods, landslides,

droughts, and glacial lake outburst floods. These hazards are expected to intensify with climate change, posing significant risks to water resources, ecosystems, and human settlements.

2. Water Scarcity and Dependence: The project area heavily relies on water resources for various sectors, including agriculture, hydropower and domestic use. However, these watersheds area already faces water scarcity issues, particularly during the dry season, which is likely to worsen with climate change. Integrated watershed management becomes crucial to optimize water availability, enhance water-use efficiency, and sustainably meet the growing water demands.

3. Ecosystem Conservation and Biodiversity: The study areas are known as rich in biodiversity, ranging from the high Himalayas to the foot hills. Ecosystems provide critical services such as water regulation, soil conservation, and habitat for diverse flora and fauna. A climate responsive integrated watershed management plan recognizes the need to conserve and restore ecosystems to maintain their ecological integrity, support biodiversity, and enhance resilience to climate change.

4. Rural Livelihoods and Food Security: The majority of Nepal's population depends on agriculture and natural resources for their livelihoods. Climate change impacts, such as changing rainfall patterns and increased frequency of extreme events, can negatively affect agricultural productivity, food security, and rural livelihoods. Integrated watershed management strategies that promote sustainable agriculture practices, water resource management, and soil conservation can help enhance the resilience of rural communities.

5. Policy and Institutional Framework: Nepal has recognized the importance of integrated water resources management through its national policies and strategies, such as the Water Resources Strategy (2002) and the National Adaptation Programme of Action (NAPA) on Climate Change. Implementing a climate responsive integrated watershed management plan aligns with the country's policy framework, strengthening institutional capacity and coordination for effective water resource management.

6. Sustainable Development Goals (SDGs): The climate responsive integrated watershed management plan aligns with the SDGs, particularly Goal 6 (Clean Water and Sanitation), Goal 13 (Climate Action), Goal 14 (Life below Water), and Goal 15 (Life on Land). It contributes to achieving these goals by ensuring sustainable and equitable management of water resources, building climate resilience, conserving ecosystems, and promoting sustainable development.

8. Collaboration and Stakeholder Engagement: Watershed management requires collaboration among diverse stakeholders, including government agencies, local communities, NGOs, and private sectors. An integrated management plan provides a platform for effective stakeholder engagement, fostering cooperation, sharing of

knowledge, and collective action. By involving stakeholders in the decision-making process, the plan can better reflect local needs and build ownership, leading to more effective and sustainable outcomes.

3.1.3 Thematic Area

Field level consultation and interaction identified that a climate-responsive integrated watershed management plan should incorporate several thematic components to effectively address the challenges posed by climate change. However, it's important to customize the plan based on local conditions, stakeholder priorities, and available resources to ensure its effectiveness and sustainability. Some recommended key thematic components for sub-watershed management are as follows:

1. **Sustainable Agriculture and Land Management:** Promote climate-smart agricultural practices that improve productivity, enhance soil health, and reduce greenhouse gas emissions. This includes promoting organic farming, agro-forestry, terrace farming, and crop diversification. Integrate soil conservation measures, such as contour plowing, bunding, and terracing, to reduce soil erosion and improve water retention.

2. **Forest and Biodiversity Conservation:** Forest has critical role in water regulation and climate resilience, this component focuses on promoting forest conservation and biodiversity enhancement. Encourage community-based forest management approaches, afforestation, enrichment plantation initiatives, and the protection of biodiversity hot spots and critical habitats. Implement measures to reduce deforestation, mitigate soil erosion, and enhance carbon sequestration.

3. **Water Induced Disaster Risk Reduction:** Given the vulnerability of the mid-mountain region to climate-related disasters, this component focuses on enhancing disaster preparedness and risk reduction measures. Implement early warning systems, slope stabilization measures, and community-based disaster management plans. Promote awareness and education on disaster risk reduction and ensure the integration of climate risk considerations into infrastructure development.

4. **Water Resource Management:** This component focuses on the sustainable management of water resources within the sub-watershed. It includes activities such as water source protection, water conservation, rainwater harvesting, groundwater recharge, and the development and improvement of small-scale irrigation systems. Emphasize the integration of traditional skill, knowledge and modern techniques to optimize water availability and improve water use efficiency.

5. Capacity Building and Institutional Strengthening: Foster active community participation and ownership throughout the watershed management process. Strengthen the capacity of three tiers of government (Federal, province, and local) as well as local institutions and user

groups to facilitate collaborative decision-making, resource management, and conflict resolution. Promote gender equality and social inclusion in decision-making processes and ensure the representation of marginalized groups.

3.2 Outcome and output

The outcomes, output and activities were identified based on TOR, series of consultation meetings among the technical team and key stakeholder, and understanding major problem of watershed degradation. Details of the outcomes of the plans with associated outputs and activities are as follows:

- **Outcome 1: Sustainable Agriculture and Land Management**
- **Outcome 2: Forest and Biodiversity Conservation**
- **Outcome 3: Water Induced Disaster Risk Reduction and Management**
- **Outcome 4: Water Resource Management**
- **Outcome 5: Capacity Building and Institutional Strengthen**

To get designated outcome, there are several specific activities under each outputs of these outcomes. A brief description of these outcomes, outputs, and activities are listed as below.

Outcome 1: Sustainable Agriculture and Land Management

Output 1: Improved sustainable agriculture, food and nutrition security and climate resilient health and hygiene.

Output 2: Economic well-being of local communities enhanced through commercial farming on agriculture and livestock to climate resilient livelihoods

Output 3: Established and functional insurance and community and peasant friendly climate induced risk sharing model expansion in both agriculture and livestock.

Output 4: Increased abundance, diversity and accessibility of landraces to strengthened livelihood

Output 5: Improved climate resilient irrigation facilities and irrigation area for agriculture production

Output 6: Climate smart transformative collective agriculture promotion adopted

Output 7: Improved integrated soil nutrient management for resilient agriculture

Output 8: Capacity of agriculture and livestock technicians, farmers substantially increased on climate change adaptation.

Output 9: Improved livelihood diversification options and income generation opportunities for communities.

Outcome 2: Forest and Biodiversity Conservation

Output 1: Increased forest cover and quality

Output 2: Enhanced biodiversity conservation.

Output 3: Reduced Dependency of local communities on natural forests

Output 4: Livelihoods of community are enhanced from community-led management of forests

Outcome 3: Water Induced Disaster Risk Reduction and Management

Output 1: Improved early warning systems and preparedness for water-induced disasters

Output 2: Enhanced infrastructure and measures for flood control and mitigation

Output 3: Strengthened community-based disaster risk reduction and preparedness.

Output 4: Improved land and water management policy to reduce erosion and sedimentation risks

Outcome 4: Water Resource Management

Outputs 1: Increased availability and access to clean water for domestic and agricultural purposes.

Output 2: Enhanced water conservation and efficiency measures.

Output 3: Increased community participation and strengthen institutional capacity in water management and decision-making.

Outcome 5: Capacity Building and Institutional Strengthening

Output 1: Enhanced knowledge and skills of stakeholders on climate-responsive integrated watershed management.

Output 2: Strengthened institutional capacity and coordination mechanisms for integrated watershed management.

Output 3: Improved coordination and collaboration among stakeholders for effective implementation of the watershed management plan.

Output 4: Enhanced gender mainstreaming and social inclusion in watershed management initiatives.

3.3 Logical Framework

Major identified outcomes of the plan for watershed are enhanced water availability and reliability through its management, forest and biodiversity conservation, increased resilience of local communities to climate-related risks, sustainable agricultural practices, reduced soil erosion and sedimentation, reduced vulnerability to water induced disasters, diversified and resilient livelihood opportunities, strengthened community institutions and participation, and improved knowledge and capacity for climate adaptation.

Similarly, outputs of the management plan would encompass the implementation of water source conservation and management measures, forest and biodiversity conservation initiatives, adoption of climate-smart agricultural practices, establishment of disaster risk reduction mechanisms, livelihood diversification programs, community-based institutions and networks, climate information services, and monitoring and evaluation systems to track progress and inform adaptive management. Based on outcomes, outputs and activities, the log frame of the project is prepared. Details of the outcomes of the plans with associated outputs, indicators, means of verification and risk and assumption is described for all components in the logical framework Table 11.

Table 10: Logical Framework

Project Name	**Preparation of Climate Responsive Integrated Watershed Management Plans for Lower Dudhkoshi and Molung Watersheds focusing on Molung Rural Municipality**
Project vision:	To ensure the sustainable management of watershed resources, enhance ecosystem resilience, and improve the livelihoods and well-being of communities within the vulnerable watershed in the face of changing climatic condition.
Project Goal:	To develop and implement strategies that effectively address the impacts of climate change on water resources, ecosystems, and communities within the vulnerable watershed. The ultimate aim is to achieve a balanced and equitable use of water, promote ecosystem health, and enhance the resilience capacity of the watershed to climate change.
Overall Objective:	To develop/formulate climate responsive evidences based on the baseline, watershed situation analysis, and problem analysis, and formulation of practical coping strategies for watershed planning and interventions to prepare climate resilient livelihood at watershed and government unit level i.e Palika level.

Outputs	Objectively Verifiable Indicators	Means of Verification	Risk and Assumption
Outcome 1: Sustainable Agriculture and Land Management			
1. Improved sustainable agriculture, food and nutrition security.	• 70 Ropani degraded land Improved by conservation farming • 3200 farmers adopted cultivation practices of crops by proper utilization of land using appropriate cropping pattern and climate resilient approach.	• Municipality/Ward and AKC progress report	• If LGS support continue on sustainable farming.
2.Economic well-being of local communities enhanced through commercial farming on agriculture	• 1050 farmers have started Commercial agriculture and livestock farm establishment •	• Municipality/Ward and AKC progress report	• Youth motivation on commercialization farming and LGS support on marketing of products

Outputs	Objectively Verifiable Indicators	Means of Verification	Risk and Assumption
3. Established and functional insurance and community and peasant friendly climate induced risk sharing model expansion in both agriculture and livestock.	• 5200 farmers benefited from insurance program	• Progress report Municipality/wards and AKC and Forest.	• Insurance agents available to provide services in remote hill district/municipality.
4.Increased abundance, diversity and accessibility of landraces to strengthened livelihood	• Increased 400 ha area for cultivation of local landraces.	• Progress report of Municipality/ Ward.	• If LGs support continue to promote indigenous crops.
5.Improved climate resilient irrigation facilities and irrigation area for agriculture production	• Increased 700 ha irrigated area. • Increased crop production and productivity of cereals by 0.5 tons/ha	• Progress report of Municipality/ Ward.	• Continue support from DOI, SIP and LGS.
• 6.Promotion of climate smart agriculture adopted	• Introduced at least 20 crop varieties and 100 livestock breeds resist to extreme weather induced by climate change and resistant to diseases and pests attack.	• Municipality/Ward and AKC progress report	• If NARC Department Of Agriculture, Department of Livestock of MOLD able to provide crop varieties seeds/saplings, breeds suitable to climate change.
7.Improved integrated soil nutrient management for resilient agriculture	• Increase soil productivity of 2100 ha land • Improve in soil nutrients content that supports the growth of all forest and agricultural plants including carbon sinks and stress tolerant varieties of 1500 ha.	• Municipality/Ward and AKC progress report	• LGS support continue on soil fertility improvement
8. Capacity of agriculture and livestock technicians, farmers substantially increased on climate change adaptation.	Capacity of 30 staff enhanced.	Progress report Municipality/wards and AKC	LGS support on capacity development on climate change

Outputs	Objectively Verifiable Indicators	Means of Verification	Risk and Assumption
9. Improved livelihood diversification options and income generation opportunities for communities.	• 100 Number of livelihood diversification options implemented.	• Project reports and documentation of livelihood diversification activities.	• Availability of technical expertise and resources to implement livelihood diversification options.
Outcome 2: Forest and Biodiversity Conservation			
1. Improved sustainable forest management practices and increased forest cover and quality.	• By 2028, at least 8 no of accessible forests handed overto CFUG for community-based forest management practices.	• Division Forest Office (DFO) annual progress report, Community Forest User Group (CFUG) minute record • Municipality progress report	• Adequate funding and resources are available to implementactivities.
2. Enhanced biodiversity conservation within the watershed.	• 3 no of hotspots of endangered flora and fauna species protected to restore within the watershed.	• DFO annual monitoring report, CFUG minutes	• Strong collaboration and coordination among stakeholders are maintained
3. Strengthened institutional capacity for forest and biodiversity conservation.	• 40 No of Training, and logistic support provided for an institutional capacity upgrade for forest and biodiversity conservation (5 in each ward)	• Institutional capacity assessment reports and evaluations.	• Supportive policies and regulations are in place to facilitate sustainable forest management
4. Increased awareness and participation of local communities in forest and biodiversity conservation activities.	• By 2027, 40 no of awareness campaigns and workshops for the participation of local communities (5 in each ward(	• DFO annual monitoring report, CFUG minutes	• Local communities are actively engaged and empowered in forest and biodiversity conservation efforts.
Outcome 3: Water Induced Disaster Risk Reduction and Management			

Outputs	Objectively Verifiable Indicators	Means of Verification	Risk and Assumption
1. Improved early warning systems and preparedness for water-induced disasters.	• By 2027, one early warning system is established and placed in function	• Early warning system reports and documentation.	• Adequate funding and resources are available to support the establishment and operation
Enhanced infrastructure and measures for flood control and mitigation.	• 200 no of flood control and mitigation structures implemented	• Progress report of SWMO, WRIDDO, and Project reports Municipality progress report, Field assessments.	• Adequate funds and technical manpower are available
Strengthened community-based disaster risk reduction and preparedness.	• 80 Number of trained community members in disaster risk reduction and preparedness.	• Training records of DAO, WRIDDO, WSSDO, community participation records, and feedback.	• Local communities are actively engaged and willing to participate in training.
4. Improved land and water management practices to reduce erosion and sedimentation risks.	• 16 ha of farmland conserved and 8 km embankment for flood control	• AKC, SWMO and WRIDDO progress report • Assessment report on erosion and sediment rate at the river bed. • Field observation	• Stakeholder cooperation and compliance with recommended land and water management
Outcome 4: Water Resource Management			
Improved water resource planning and governance	• 2 no of integrated water resource management plans in each ward	• Water resource management plans, reports, and monitoring data.	• Adequate funding and resources are available to support the implementation of water resource management activities.

Outputs	Objectively Verifiable Indicators	Means of Verification	Risk and Assumption
2. Increased availability and access to clean water for domestic and agricultural purposes.	• 1040 no of households have one tape in each HH for improved access to clean water (130 in each ward).	• WSSDO progress report • Palika water quality monitoring reports • WUG minute	• Strong collaboration and coordination among stakeholders are maintained throughout the implementation process.
3. Enhanced water conservation and efficiency measures.	• 80 no of water use efficient techniques adopted in agricultural sectors	• WSSDO and SWMO progress report • Municipality report Water use data, project report	• Supportive policies regulations and funding are in place to promote water conservation and efficient water use.
4. Improved watershed management practices to reduce soil erosion and enhance water quality.	• 80 no of water resources protected from landslides and managed for improved water quality	• WSSDO and SWMO progress report • Municipality progress report	• Local communities are actively engaged and empowered in watershed management activities.
5. Strengthened institutional capacity for water resource management.	• Improved logistic support in institutional capacity assessments for water resource management.	• WSSDO and SWMO progress report	• Technician and water user groups are capable to implement water resource management activities
6. Increased awareness and knowledge of water resource management practices among local communities and stakeholders.	• 80 no of awareness campaigns and workshops on water resource management practices	• Surveys, training records, and community feedback.	• Local communities and stakeholders actively participate in water resource management activities and decision-making processes
Outcome 5: Capacity Building and Institutional Strengthening			
1. Enhanced knowledge and skills of stakeholders on climate-responsive integrated watershed management.	• 80 Number of stakeholders trained on climate-responsive integrated watershed management.	• Training reports, attendance sheets, and evaluation feedback.	• Adequate funding is available forcapacity-building activities.

Outputs	Objectively Verifiable Indicators	Means of Verification	Risk and Assumption
2. Strengthened institutional capacity and coordination mechanisms for integrated watershed management.	• 8 no of upstream and downstream forums formed and logistic support for service provider for IWMP	• Institutional capacity assessment reports and evaluations.	• Supportive policies and regulations are in place to facilitate IWM
3. Improved coordination and collaboration among stakeholders for effective implementation of the watershed management plan.	• 40 Number of stakeholder meetings and collaborations performed	• Meeting minutes, collaboration agreements, and progress reports.	• Strong commitment and participation from stakeholders in implementing the IWM plans
4. Enhanced gender mainstreaming and social inclusion in watershed management initiatives.	• 800 Numbers of women and socially excluded HH involve in training and plan implementation	• Training reports, minute records, and attendance sheets	• Adequate funding and resources are available for mainstreaming activities.

3.4 Action Plan

The action plan of Lower Dudhkoshi Watershed comprises the proposed activities for 5 years period as given in TOR. Details activity wise cost calculation is given in (Table 13-Table 17) and year wise action plan is in Table 18. The basis for selection of wards/location, cost calculation was based on field survey, interaction directly contact with experts where possible, KII, considering own experience and field observation. Summary of the cost is shown in Table 12.

Table 11: Summary of cost calculation

Action plan	**Estimated cost (In 000,NRS)**
Outcome 1: Sustainable Agriculture and Land Management	3,147,200
Outcome 2: Forest and Biodiversity Conservation	56,060
Outcome 3: Water-Induced Disaster Risk Reduction and Management	1,60,400
Outcome 4: Water Resource Management	1,85,300
Outcome 5: Capacity Building and Institutional Strengthening	12,600
Total	**3,561,560**

Table 12: Outcome 1: Sustainable Agriculture and Land Management

Activities	Sub-Activities	Interventions wards/Location	Estimated cost (in 000,NRS)
Output1: Improved sustainable agriculture, food and nutrition security			
• Increase crop production through sustainable agriculture practice and climate change adaptation.	• Promotion of intercropping in fruit orchard; Use indigenous knowledge for pest management; Cultivation crops combine with forest/fodder tree species; Home gardening utilizing waste water of kitchen. Protecting crops and animals from damaging /killing from wild animals.	• Ward-1 (Dhakal Gauon, Sahalar & Thapachour) Main crops grown are paddy maize, millet wheat, buckwheat,potato and mustard. • Ward -2 (Rampur, Torisahar Thuskelamidanda,Dadhuwa Muhan, Tehanpur and Mahabhir) crops grown are rice, maize, millet, potato, mustard • Ward -3 (Gopehaki, Phiddim, Bhrigr, gogundanda, Chautar,prapcha) Crops grown are maize, paddy,wheat, tori and buckwheat. • Ward 4 (Harkapur, Dandabensi, Rupetar, Kharkheti, Jasaptar, Jaljale, Kunduledhap, Phattegauon) crops grown are paddy, maize wheat, millet, potato, oybean, mustard. • Ward 5- Main crops grown are paddy maize, millet wheat, buckwheat, soybean, potato and mustard. • Ward 6- Main crops grown are paddy maize, millet wheat, buckwheat, soybean, potato and mustard. • Ward-7 Main crops grown are maize, millet, wheat, buckwheat, potato, • Ward-8 Main crops grown are maize, millet, paddy, wheat, buckwheat, potato,mustard and vegetables	3100.0
Output 2: Economic well-being of local communities enhanced through commercial farming on agriculture and livestock to climate resilient livelihoods			
• Diversify rural livelihoods and increase incomes through commercialization of	• Commercial cultivation of high value horticultural crops. (fruit, vegetables, spices crops, cash crops) ;	• Nursery establishment for fruits and vegetables: one in each ward • Ward 1 lemon Kiwi, coffee • Ward -2 Fruits and off season vegetables • Ward-3 Potato pocket	7600.0

agriculture and Livestock farming.		• Ward 4- Potential for coffee, banana, off season vegetables and fruits. • Ward 5- Potential for off season vegetables • Ward 6- Fruits, apple, Kiwi and many other species) Potato and off season and seasonal vegetables. • Ward -7 Potential for cultivation of citrus, banana, coffee, aakabre chilli, potato and off season vegetables. • Ward -8 Potential for cultivation of citrus, cardamom Kiwi fruit, apple, coffee and potato. • Bee keeping: Potential few wards • Crops commercial farming selected few Wards • Livestock commercial farming selected Wards	
Output 3: Established and functional insurance and community and peasant friendly climate induced risk sharing model expansion in both agriculture and livestock.			
• Initiate program on Crop and Livestock Insurance to minimize risk due to extreme weather conditions.	• Prepare a list of private insurance company of agriculture and livestock and make agreement for crop livestock insurance; Awareness program and capacity building	• All wards	500
Output 4: Increased abundance, diversity and accessibility of landraces to strengthened livelihood			
• Identify, collect and proper conservation of local land races to develop climate resilient crop varieties.	• Establish Community Seed bank and Conduct seed multiplication program of different crops to make self-sufficient in seeds; Promotion of indigenous crops, seed production and storage.	• Potential wards (at least one community seed bank in the municipality)	1000

Output 5: Conduct program to identify and design construction of irrigation canal and promote water harvesting technology			
• Identify the potential source of water for irrigation, design and construct irrigation canal repair and maintenance. • Rain water harvesting using roof water collection, Plastic ponds, small and medium sized reservoir tank construction	• Irrigation canal support,lift irrigation, cutting management, ponds construction and pipes management	• Ward -1 Dhakal Gauon, Sahalar & Thapachour Lift irrigation • Ward -2 Rampur, Torisahar Thuske lamidanda, Dadhuwa Muhan, Tehanpur and Mahabhir • Ward -3 Gopehaki, Phiddim, Bhrigr, gogundanda, Chautar,prapcha • Ward- 4 (Harkapur, Dandabensi, Rupetar, Kharkheti, Jasaptar, Jaljale, Kunduledhap, Phattegauon) irrigation canal from kulkhola and molung khola resources. • Ward -5 Lift irrigation • Ward- 6 Irrigation canal from water source of patkharikhola, nubu khola and selele khola • Ward -7 Irrigation canal improvement, lift irrigation • Ward -8. Irrigation canal, Pipes and ponds	3,131,000.00
Output 6: Climate smart transformative collective agriculture promotion adopted			
• Conduct program to explore, assess and promote climate smart technology.	• Conduct program to introduce crop varieties resistant to drought, disease and pest; Conduct Zero or minimum tillage practices of wheat in few wards of municipality; Introduce system of using Green Color Chart (GCC) to determine nitrogen level in soil; Use of SRI technology in rice cultivation.	• Selected wards	800
Output 7: Improved integrated soil nutrient management for resilient agriculture			

• Conduct program to improve soil fertility and nutrient management	• Program to demonstration of Compost making and bio fertilizer & vermi- compost; Plantation of green manure such as Dhaincha demonstration; Cowshed improvement program; Agro forestry promotion; Promote plantation of legume species such as IPIL-IPIL and low water consuming tree; carbon farming	• All wards	700
Output 8. Capacity of agriculture and livestock technicians, farmers substantially increased on climate change adaptation.			
• Capacity building of agriculture technicians, farmers from climate change perspective.	• Enhance the capacity of agriculture technicians; Organize exposure tours visit and capacity development program.	• All wards	1200
Output 9: Improved livelihood diversification options and income generation opportunities for communities.			
• Diversify livelihoods through commercialization in agriculture and forestry.	• Conduct income generating activities on crop , livestock and forest sectors in commercial scale	• All wards	1300

Table 13: Outcome 2: Forest and Biodiversity Conservation

Activities:	Sub-activities	Intervention location/ward	Estimated cost(in 000, NRS)
Output 1: Increased forest cover and quality			
1. Forest Inventory and Assessment:	Forest inventory	In all wards	800
	Vulnerability assessment	In all Wards	500
2. Community-based Forest Management	CFUG formation 8 no	In Wards 1 to 8	120
	CFOMP renewal and preparation to incorporate climate change concern	In all 35 CFUGs of ward 1 to 8	1750
	Forest management training (silviculture, invasive species, and regeneration management (1 in each ward for 3 years)	In Wards 1 to 8	1440
3 Reforestation and Afforestation	High tech Nursery establishment	One in ward 5 Pracha Deurali Palika center	1500
	Seedling production forest species 50,000 no for 3 years	In Palika nursery	2250
	NTFPs seedlings production 50, 000 no for 3 years	In Palika nursery	3000
	Plantation (Enrichment/afforestation with weeding) 24 ha	In Wards 1 to 8	4800
4 Forest Conservation and Protection:	Enhance Forest paroling	In all wards of rural municipality	500
	Involve CFUGs in forest monitoring and surveillance.	In all wards of rural municipality	500
	Control forest fires, pests, and diseases	All 35 CFUGs in the wards	800
Output 2: Enhanced biodiversity conservation			
5.Biodiversity Conservation	Protection of endanger species and hotspots 3 no	The potential area of ward no 1 to 8	1500
	NTFPs and medicinal plants cultivation 16 ha	In Wards 1 to 8	3200
Output 3: Reduced Dependency of local communities on natural forests			
6.Public private partnership	Promote Private plantation 8 ha	In Wards 1 to 8	800
	Promote agroforestry on public and private land 16 ha	In Wards 1 to 8	16000
Output 4: Livelihoods of community are enhanced through CBFM system			
7.Provide technical support	Promote Green IGAs (Broom grass and Cardamom cultivation) 16 packages	In Wards 1 to 8	8000
	Promote private forest nursery	In potential area	600
	Provide support to promote eco-tourism development 8 package	In Wards 1 to 8	8000

Table 14: Outcome 3: Water Induced Disaster Risk Reduction and Management

Activities:	Sub-activities	Intervention location/ ward	Estimated cost(in 000, NRS)
Output 1: Improved early warning systems and preparedness for water-induced disasters			
1. Hazard Assessment and Mapping	• Identify Water-induced hazard (floods, landslides, and debris flow)	In Rural Municipality level	1000
	• Implement hazard and vulnerability maps	In Rural Municipality level	500
	Analyze historical data and climate projections	In Rural Municipality level	500
Early Warning Systems	Establish early warning systems	In Rural Municipality level	1000
	Install rain gauges, river level sensors, and landslide sensors.	In Rural Municipality level	1000
	Develop procedures and protocols for an early warnings system	In Rural Municipality level	500
Output 2: Enhanced conservation measures for flood control and mitigation			
Implement soil and water conservation measures	Integrated soil erosion control measures, such as torrent control, retaining walls, landslide treatment and bioengineering techniques 30 packages	Ward 1 (1 no), ward 2 (3 no), ward 3 (2 no), ward 4 (5 no), ward 5 (2 no), ward 6 (4 no), ward 7 (7 no), and ward 8 (6 no)	30000
	River band protection (spurs, embankments, retaining walls, integrating bioengineering. (16 km about 2 km in each ward)	Ward 1: *Chore khola and Dhobi Khola;* ward 2: *Molung Pokting, Jhagarpur and Lipe khola;* ward 3: *Prapcha, Kul and Khalte khola;* ward 4: *Ghatte and Molung khola;* Ward 5: *Molung and Gaun khola;* ward 6: *Patkari, Ghumaune, Selele, Amile and Mangalbare khola;* ward 7: Khani khola, *Lapse, Ghatte khola, Bakhre khola, Change khola, ward 8 Sepli, Molung and Sirese khola*	64000
	Promote nature-based solution (Reforestation, slope stabilization, gulley plugging and grass planting) in 52 rural road network	In problematic rural access road of ward 1 to 8	20,000
	Climate change Adaptation modal Village program (5 package for 5 years)	Sensitive settlements of ward 1 to 8 ward of municipality	37500

Activities:	Sub-activities	Intervention location/ ward	Estimated cost(in 000, NRS)
Output 3: Strengthened community-based disaster risk reduction and preparedness			
Community Preparedness and Capacity Building	Conduct disaster-related training (1 in each ward for 5 years)	In all wards of rural Municipality level	2400
	Promote a community-based disaster management committee.	In Rural Municipality level	500
Output 4: Improved land and water management policy to reduce erosion and sedimentation risks			
Policy and Institutional Support	Advocate for policies and regulations	State, district, watershed, and rural municipality level	500
	Promote coordination and collaboration	District, watershed, and rural municipality level	500
	Integrate disaster risk reduction concerns into planning processes	District and rural municipality level	500

Table 15: Outcome 4: Water Resource Management

Activities:	Sub-activities	Intervention location/ward	Estimated cost(in 000, NRS)
Output 1: Increased availability and access to clean water for domestic and agricultural use			
Conduct Water Resource Assessment	Water resources survey (surface water, groundwater and availability, quality, and trends)	In Wards 1 to 8	500
	Assess the impacts of climate change, scarcity and vulnerability	In Wards 1 to 8	500
Develop Water Allocation and Management Plans	Irrigation canal improvement 24 packages (1 in each ward for 3 years)	Pokting Mulkhark –Sikhani Irrigation, ward 8; Rampur irrigation (Branch cnanl repair)-ward 2; Ghalegaau-Bahunbari-lamakhara-ward 4; Beli chameli lower canal repair-ward 4; Piple canal repair-ward 4; Okhaldhunga	24000

Activities:	Sub-activities	Intervention location/ward	Estimated cost(in 000, NRS)
		Gautri Khudukri irrigation-ward 5; Molung Gara irrigation canal-ward 5.	
	Set up water allocation protocols	All wards	500
Output 2: Enhanced water conservation and efficiency measures.			
Implement Water Conservation and rainwater Harvesting Measures	Rainwater harvesting measures (Plastic pond, rooftop rainwater storage and ponds: a total of 40 package)	Ward 1 (5 no), ward 2 (5 no), ward 3 (3 no), ward 4 (5 no), ward 5 (3 no), ward 6 (5 no), ward 7 (5 no), and ward 8 (11 no)	40000
	Water source management (Intake, storage tank, pond, tap stand and irrigation canal as per site requirement)Total 62 packages	Ward 1(1 no), ward 2 (8 no), ward 3(5 no), ward 4 (6 no), ward 5(5 no), ward 6(16 no), ward 7(15 no), and ward 8 (6 no)	62000
	Wetland conservation 12 packages	In ward 1 *Dhamal Pandhero Kuntadevi and Simpani Pandhero,* ward 2 *Dunde Simle Rampur and Aale Jhagarpat*, ward 4 *Mahadev Khola, Opipatur Harkapur and Jaljala,* ward 6 *Bojotar, Chepte, Patkari, Chaite Kharka* and ward 8 *Sepli and Paner Danda Gaun*	12000
	Implement sprinkle and drip irrigation system (In dry land management) 1 package in each ward for 5 years total 40 no	On upland sloppy area	40000
Water Use Efficiency	Training on efficient water use techniques (water user group) 40 event	In all wards	2400
	Water pricing mechanisms	In all wards	500
Output 3: Increased community participation and strengthen institutional capacity			
Capacity Building and Community participation	Awareness raising training to WUG1 in each ward for 5 years total 40 events	In all wards	2400
	Logistic support to local institutions	In all wards	500

Table 16: Outcome 4: Capacity Building and Institutional Strengthening

Activities:	Sub-activities	Intervention location/ward	Estimated cost(in 000, NRS)
Output 1: Enhanced knowledge and skills of stakeholders on CRIWM			
Conduct Training and Workshops	Provide training on climate change and adaptation measures	In Rural Municipality level	2400
	Workshops and exposure visits on climate adaptation planning	In Rural Municipality level	500
Output 2: Strengthened institutional capacity and coordination mechanisms for CRIWMP implementation			
Develop Training Materials and Resources	Create training modules and guidelines on climate change adaptation	In Rural Municipality level	500
Enhance coordination and Collaboration	Organize joint meetings among government agencies, NGOs and CBOs	In Rural Municipality level	500
	Establish mechanisms for joint planning, implementation, and monitoring	In Rural Municipality level	500
Output 3: Increased awareness and understanding of climate change impacts and resilience-building measures.			
Promote Community Engagement and Participation	Organize workshops and meetings on climate change impacts and adaptation measures	In Rural Municipality level	500
	Training for women, marginalized groups, and youth (1 in each ward)	In Rural Municipality level	2400
Output 4: Enhanced gender mainstreaming and social inclusion in watershed management initiatives.			
Mainstream Gender and Social Inclusion	Gender mainstreaming training (1 in each ward)	In Rural Municipality level	2400
	Leadership development training to women (1 in each ward)	In Rural Municipality level	2400
	Involve marginalized and vulnerable groups in the planning and implementation	In Rural Municipality level	500

Table 17: Year wise action plan

S.N	Description of Activities	Unit	Five year		Year I		Year II		Year III		Year IV		Year V	
			Total Target	total Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget
C 01: Sustainable Agriculture and Land Management														
1	Increase crop production through sustainable agriculture practice and climate change adaptation.	Nos	100	3100	20	620	20	620	20	620	20	620	20	620
2	Diversify rural livelihoods and increase incomes through commercialization of agriculture and Livestock farming.	Nos	65	7600	13	1520	13	1520	13	1520	13	1520	13	1520
3	Initiate program on Crop and Livestock Insurance to minimize risk due to extreme weather conditions.	Nos	400	500	80	100	80	100	80	100	80	100	80	100
4	Identify, collect and proper conservation of local land races to develop climate resilient crop varieties.	Nos	160	1000	32	200	32	200	32	200	32	200	32	200

S.N	Description of Activities	Unit	Five year		Year I		Year II		Year III		Year IV		Year V	
			Total Target	total Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget
5	Identify the potential source of water for irrigation, design and construct irrigation canal repair and maintenance. Rain water harvesting using roof water collection, Plastic ponds, small and medium sized reservoir tank construction	No	21	3131000	5	149,095	4	149095	4	149095	4	149095	4	149095
6	Conduct program to explore, assess and promote climate smart technology.	Nos	100	800	20	200	20	200	20	200	20	100	20	100
7	Conduct program to improve soil fertility and nutrient management.	Nos	80	700	16	200	16	200	16	100	16	100	16	100
8	Capacity building of agriculture technicians, farmers from climate change perspective.	Nos	6	1200	2	400	2	400	2	400	0	0	0	0
9	Diversify livelihoods through	Nos	201	1300	41	300	40	300	40	300	40	200	40	200

S.N	Description of Activities	Unit	Five year		Year I		Year II		Year III		Year IV		Year V	
			Total Target	total Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget
	commercialization in agriculture and forestry.													
	Total			3147200		152635		152635		152535		151935		151935
C 02: Forest and Biodiversity conservation														
2.1	Forest inventory	No	1	800	1	800								
2.2	Vulnerability assessment	No	1	500	1	500								
2.3	CFUG formation 8 no	No	8	120	8	120								
2.4	CFOMP renewal and preparation to incorporate climate change concern	No	35	1750	20	1000	15	750						
2.5	Forest management training (silviculture, invasive species, and regeneration management	Event	24	1440	5	300	5	300	5	300	5	300	4	240
2.6	High tech Nursery establishment	No	1	1500	1	1500								

S.N	Description of Activities	Unit	Five year		Year I		Year II		Year III		Year IV		Year V	
			Total Target	total Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget
2.7	Seedling production forest species (no in 000) for 3 years	No	150	2250	50	750	40	600	30	450	30	450		
2.8	NTFPs seedlings production (no in 000) for 3 years	No	150	3000	50	1000	40	800	30	600	30	600		
2.9	Plantation (Enrichment/afforestation with weeding) 24 ha	Ha	24	4800			6	1200	6	1200	6	1200	6	1200
2.10	Enhance Forest paroling	No	5	500	1	100	1	100	1	100	1	100	1	100
2.11	Involve CFUGs in forest monitoring and surveillance.	No	5	500	1	100	1	100	1	100	1	100	1	100
2.14	Control forest fires, pests, and diseases	No	5	800	1	160	1	160	1	160	1	160	1	160
2.15	Protection of endanger species and hotspots	No	3	1500	1	500	1	500	1	500				
2.16	NTFPs and medicinal plants cultivation	Ha	16	3200			4	800	4	800	4	800	4	800

S.N	Description of Activities	Unit	Five year		Year I		Year II		Year III		Year IV		Year V	
			Total Target	total Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget
2.17	Promote Private plantation	Ha	8	800			1	800						
2.18	Promote agroforestry on public and private land	ha	16	16000	4	4000	3	3000	3	3000	3	3000	3	3000
2.19	Promote Green IGAs (Broom grass and Cardamom cultivation)	Package	16	8000	4	2000	3	1500	3	1500	3	1500	3	1500
2.20	Promote private forest nursery	No	1	600	1	600								
2.21	Provide support to promote eco-tourism development	Package	8	8000	2	2000	2	2000	2	2000	1	1000	1	1000
	Total			**56060**		**15430**		**12610**		**10710**		**9210**		**8100**
C 03: Water Induce Disaster Reduction and Management														
3.1	Water-induced hazard assessment (floods, landslides, and debris flow)	No	1	1000	1	1000								
3.2	Implement hazard and vulnerability maps	No	1	500	1	500								

S.N	Description of Activities	Unit	Five year		Year I		Year II		Year III		Year IV		Year V	
			Total Target	total Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget
3.3	Analyze historical data and climate projections	No	1	500	1	500								
3.4	Establish early warning systems	No	1	1000	1	1000								
3.5	Install rain gauges, river level sensors, and landslide sensors.	No	1	1000	1	1000								
3.6	Develop procedures and protocols for an early warnings system	No	1	500	1	500								
3.7	Implement nature-based solutions (plantation, slope stabilization, gulley plugging, and grass planting)	Package	30	30000	6	6000	6	6000	6	6000	6	6000	6	6000
3.8	River band protection (spurs, embankments, retaining walls, integrating bioengineering. (2 km in each ward)	Km	16	64000	3.2	12800	3.2	12800	3.2	12800	3.2	12800	3.2	12800
3.9	Integrated soil erosion control measures (terracing, retaining walls,	Package	52	20,000	11	4000	11	4000	10	4000	10	4000	10	4000

S.N	Description of Activities	Unit	Five year		Year I		Year II		Year III		Year IV		Year V	
			Total Target	total Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget
	landslide treatment, and bioengineering)													
3.10	Climate change Adaptation modal Village program (5 packages for 5 years)	Package	25	37500	5	7500	5	7500	5	7500	5	7500	5	7500
3.11	Conduct disaster-related training	Event	40	2400	8	480	8	480	8	480	8	480	8	480
3.12	Promote a community-based disaster management committee.	No	5	500	1	100	1	100	1	100	1	100	1	100
3.13	Advocate for policies and regulations	No	5	500	1	100	1	100	1	100	1	100	1	100
3.14	Promote coordination and collaboration	No	1	500	1	500								
3.15	Integrate disaster risk reduction concerns into planning processes	No	5	500	1	100	1	100	1	100	1	100	1	100
	Total			**160400**		**36080**		**31080**		**31080**		**31080**		**31080**
C04: Water Resource Management														

S.N	Description of Activities	Unit	Five year		Year I		Year II		Year III		Year IV		Year V	
			Total Target	total Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget
4.1	Water resources survey (surface water, groundwater and availability, quality, and trends)	No	1	500	1	500								
4.2	Assess the impacts of climate change, scarcity and vulnerability	No	1	500	1	500								
4.3	Improve and maintain irrigation canal	Package	24	24000	5	5000	5	5000	5	5000	5	5000	4	4000
4.4	Set up water allocation protocols	No	1	500	1	500								
4.5	Rainwater harvesting measures (Plastic pond, rooftop rainwater storage and ponds: a total of 40 package)	Package	40	40000	8	8000	8	8000	8	8000	8	8000	8	8000
4.6	Water source management (Intake, storage tank, pond, tap stand and irrigation canal as per site requirement)Total 62 packages	Package	62	62000	13	13000	13	13000	12	12000	12	12000	12	12000

S.N	Description of Activities	Unit	Five year		Year I		Year II		Year III		Year IV		Year V	
			Total Target	total Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget
4.7	Wetland conservation 12 packages	Package	12	12000	3	3000	3	3000	2	2000	2	2000	2	2000
4.8	Implement sprinkle and drip irrigation system (In dry land management) 1 package in each ward for 5 years	Package	40	40000	8	8000	8	8000	8	8000	8	8000	8	8000
4.9	Training on efficient water use techniques (water user group) 40 event	Event	40	2400	8	480	8	480	8	480	8	480	8	480
4.10	Water pricing mechanisms	No	1	500	1	500								
4.11	Awareness raising training to WUG	Event	40	2400	8	480	8	480	8	480	8	480	8	480
4.12	Logistic support to local institutions	No	1	500	1	100	1	100	1	100	1	100	1	100
	Total			**185300**		**40060**		**38060**		**36060**		**36060**		**35060**
C05: Capacity Building and Institutional Strengthening														
5.1	Provide training on climate change and	Event	40	2400	8	480	8	480	8	480	8	480	8	480

S.N	Description of Activities	Unit	Five year		Year I		Year II		Year III		Year IV		Year V	
			Total Target	total Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget
	adaptation measures (1 in each ward for 5 years)													
5.2	Workshops and exposure visits on climate adaptation planning	Event	1	500	1	500								
5.3	Create training modules and guidelines on climate change adaptation	No	1	500	1	500								
5.4	Organize joint meetings among government agencies, NGOs and CBOs	Event	5	500	1	100	1	100	1	100	1	100	1	100
5.5	Establish mechanisms for joint planning, implementation, and monitoring	No	5	500	1	100	1	100	1	100	1	100	1	100
5.6	Organize workshops and meetings on climate change impacts and adaptation measures	Event	5	500	1	100	1	100	1	100	1	100	1	100
5.7	Training for women, marginalized groups, and youth (1 in each ward for 5 years)	Event	40	2400	8	480	8	480	8	480	8	480	8	480

S.N	Description of Activities	Unit	Five year		Year I		Year II		Year III		Year IV		Year V	
			Total Target	total Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget	Quantity	Budget
5.8	Gender mainstreaming training (1 in each ward for 5 years)	Event	40	2400	8	480	8	480	8	480	8	480	8	480
5.9	Leadership development training to women (1 in each ward for 5 years)	Event	40	2400	8	480	8	480	8	480	8	480	8	480
5.10	Involve marginalized and vulnerable groups in the planning and implementation	No	5	500	1	100	1	100	1	100	1	100	1	100
	Total			**12600**		**3320**		**2320**		**2320**		**2320**		**2320**

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Annex

1. Study area and Population

Table 1.1: Molung RM ward area and population

Ward no.	Area within watershed (km2)	ward % area within watershed	Number of households	Population			Population density	Average household size
				Total	Male	Female		
1	11	100	584	2224	1055	1169	210	3.8
2	15	100	882	3327	1601	1726	228	3.8
3	10	100	299	1206	589	617	122	4.0
4	15	100	484	1899	892	1007	127	3.9
5	6	100	347	1441	699	742	254	4.2
6	18	100	527	2325	1166	1159	127	4.4
7	21	100	455	2031	1039	992	97	4.5
8	17	100	491	1987	986	1001	114	4.0
Total	112		4069	16440	8027	8413	146	33

2. Biophysical Analysis

Table 2.1: Land use of all wards of Molung Rural Municipality as per ICMOD 2019 data

Ward no	LULC	Area	Ward no	LULC	Area
1	Water	0.023	5	Forest	2.178
	Forest	6.258		Built-up area	0.003
	Built-up area	0.008		Cropland	2.860
	Cropland	3.998		Grassland	0.628
	Grassland	0.184	6	Forest	15.436
2	Water	0.043		Built-up area	0.031
	Forest	8.707		Cropland	2.431
	Built-up area	0.030		Grassland	0.146
	Cropland	5.147	7	Forest	16.032
	Grassland	0.535		Built-up area	0.014
3	Water	0.002		Cropland	3.456
	Forest	6.555		Grassland	1.436
	Built-up area	0.003	8	Forest	11.875
	Cropland	2.674		Built-up area	0.007
	Grassland	0.606		Cropland	5.089
4	Water	0.049		Grassland	0.346
	Forest	7.274			

Ward no	LULC	Area	Ward no	LULC	Area
	Built-up area	0.017			
	Cropland	6.388			
	Grassland	1.135			

Table 2.2: Land use type area within Molung RM for four decade

Landuse/Area(km^2)	2019	2010	2000	1990
Forest	75	70	68	75
Shrubland	0	0	0	0
Grassland	5	3	1	1
Agriculture area	32	38	42	37
Barren area	0	0.001	0.2	0.1
Water body	0.1	0.3	0.4	0.02
Built-up area	0.1			

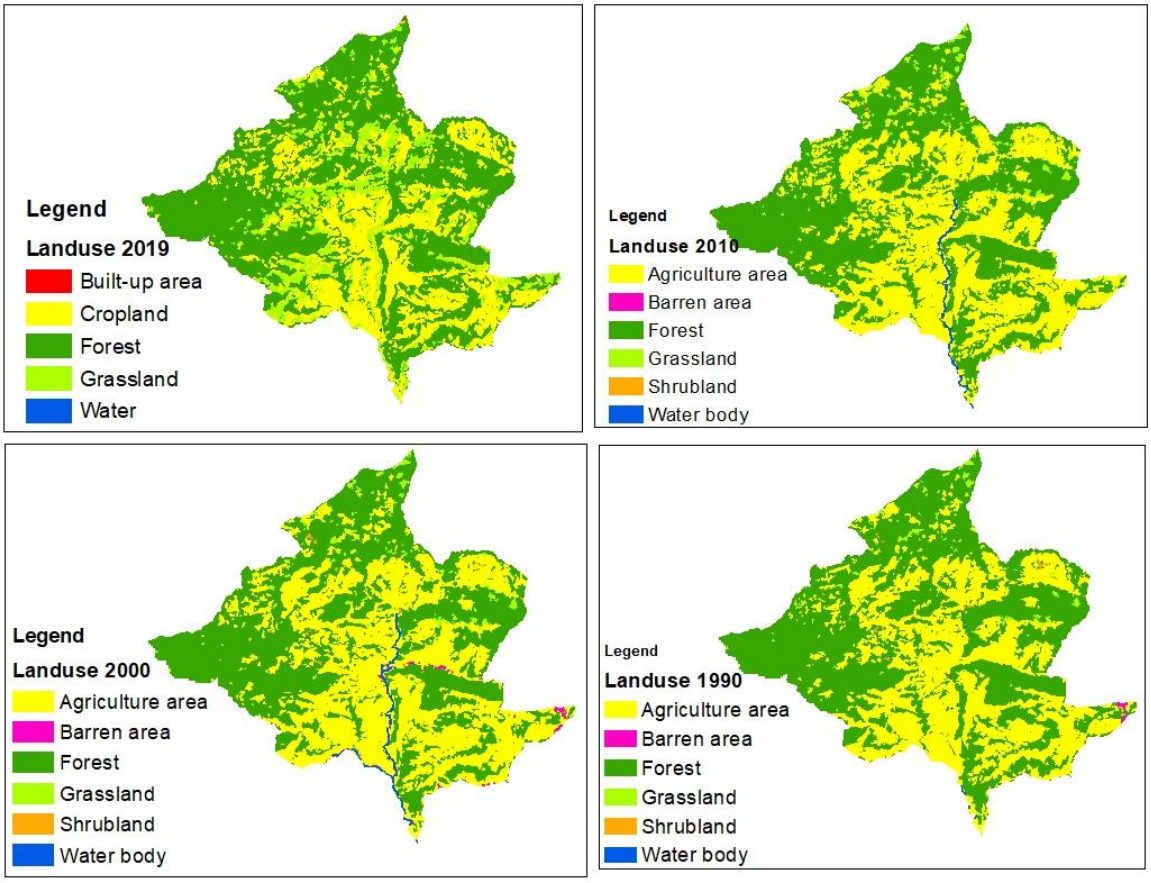

Figure 2.1: Land use change in four decades

Table 2.3: Wetland of Molung RM across all ward as per primary survey, 2023.

Ward no	Wetland Name	Condition/status	Recommended conservation measures
1	Dhamal Pandhero Kuntadevi and Simpani Pandhero	Vulnerable	Stone masonry, inlet outlet construction,
2	Dunde Simle Rampur and Aale Jhagarpat	Highly risk	Stone masonry, inlet outlet construction, plantation
4	Mahadev Khola, Opipatur Harkapur and Jaljala	Vulnerable	Excavation, Stone masonry, plantation
6	Bojotar, Chepte, Patkari, Chaite Kharka	Vulnerable	Stone masonry, inlet outlet construction, plantation
8	Sepli and Paner Danda Gaun	Highly risk	Excavation, Stone masonry, plantation, Irrigation canal
	Total		

3. Sub-watershed

Table 3.1: Sub-watershed number, area of Molung watershed

Sub basin	Area (km^2)	Sub basin	Area (km^2)	Sub basin	Area (km^2)
1	11	10	11	19	19
2	43	11	6	20	20
3	13	12	23	21	13
4	15	13	14	22	4
5	10	14	6	23	12
6	10	15	12	24	18
7	11	16	31	25	9
8	26	17	12	26	28
9	13	18	18		

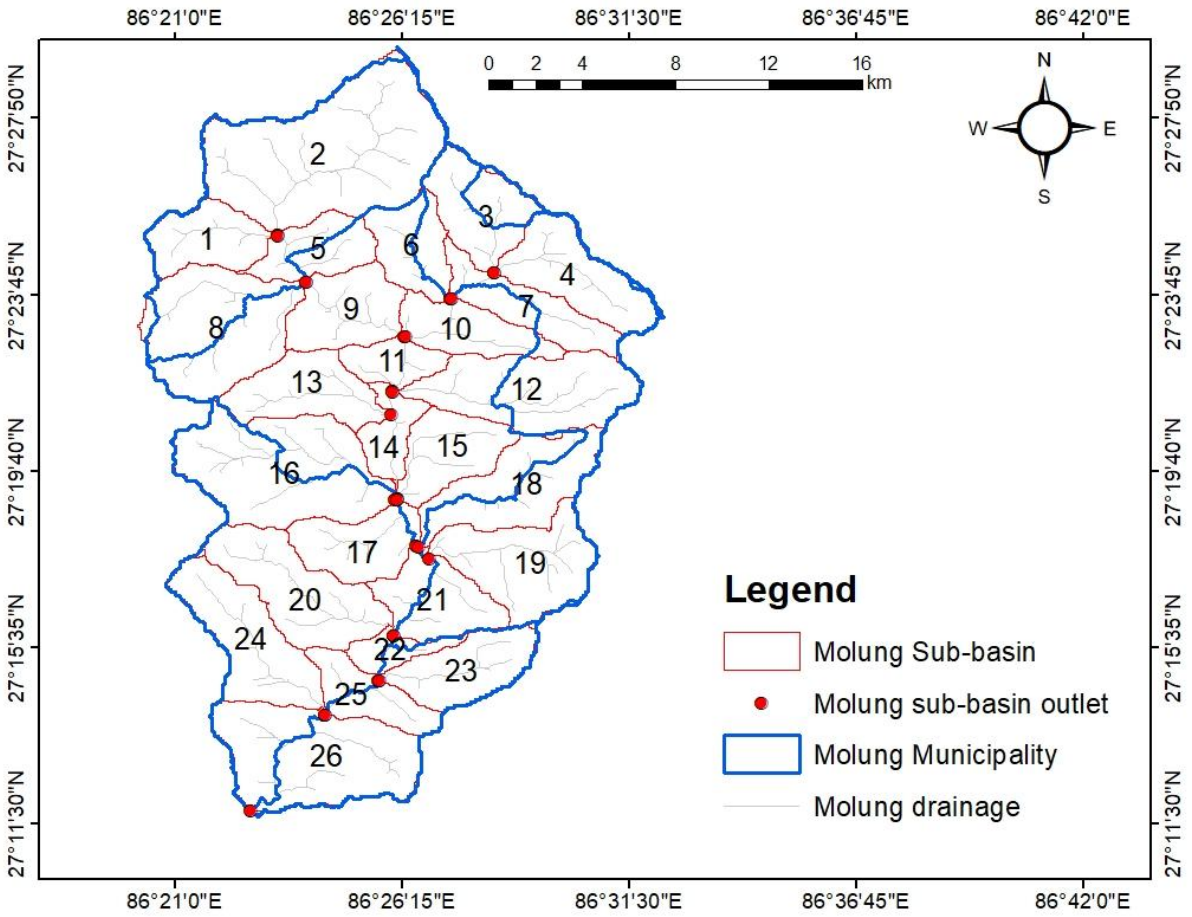

Figure 3.1: Sub-watershed number and Municipality of Molung Watershed

4. Status of irrigation

Table 4.1: List of Molung RM irrigation project from Department of Irrigation

Irrigation project	VDC	Ward no	Programme	Source	Source type	Status	GCA (ha)	NCA(ha)
BELI CHAMELI ISP	Harkapur	4	CMIASP	Kakani Khola	Perennial	Operational	59	50
KAKANI KHOLA IP	Harkapur	4	SIP	Kakani Khola	Local Stream	Operational	14	13.2
GADI BHULBHULE TATHA SOPHALI DHADE MUL KULO ISP	Harkapur & Prapcha	3	CMIASP	Sopli Khola	Local Stream	Operational	35	28
LIPE KHOLA BASERI ISP	Kuntadevi	1	CMIASP	Lipe Khola	Perennial	Non Operational	33	30

Irrigation project	VDC	Ward no	Programme	Source	Source type	Status	GCA (ha)	NCA(ha)
SOPLI PANCHGHARE IP	Prapcha	3	SIP	Sopli Khola	Local Stream	Operational	22	17
MOLUNG IP	Shree chaur	5, 3	MIP	Moulong Khola	Perennial	Operational	83	66.4

Table 4.2: Completed small irrigation project in Molung RM

Sno.	Project Name	Command Area (ha)	Project Completed	Beneficiary HHs	Disadvantaged Group HHs	Small Land Holders HHs	Women Headed HHs
1	Tallotar dalit basti IP	16	Yes	85	41	83	3
2	Gaukhola Kolchaur Dovan IP	7	Yes	44	9	39	0
3	Khalte khola phuyalgau ghale bada sichai yojana	9	Yes	63	27	56	8
4	Saitar Dhagerni Irrigation Project	10	Yes	55	9	52	3
5	Kool Khola Dhad Besi Sichai Yojana	10	Yes	91	33	90	8
6	Dipli IP	6	Yes	43	43	38	7
7	Khahare Khola Mane Salleri Gurukul Harkpur Sichai Yojana	11	Yes	74	18	68	3

Table 4.3: Ongoing small irrigation project in Molung RM

Sno.	Project Name	Command Area (ha)	Project Completed	Beneficiary HHs	Disadvantaged Group HHs	Small Land Holders HHs	Women Headed HHs
1	Kakani Khola Muhan Hudai Dumse IP	6	No	22	19	19	3
2	Pharsi Gaira Simle Chilaune IP	6	No	36	13	31	7
3	Jalum Juldikha kulo IP	7	No	25	15	21	1
4	Gairikhet IP	5	No	30	14	30	4
5	Bungkati Chiuribote IP	9	No	38	18	18	6
6	Dude Simlekhet IP	9	No	44	11	43	0

5. Multihazard and risk Hazard

Table 5.1: Landslide (Nepal Disaster Risk Reduction Portal, 2023)

S.No.	Ward No.	Incident Place	Incident Date	Total Death	Affected Family	Estimated Loss	Private House Fully Damaged	Private House Partially Damaged
1	7		7/14/2018	0	7		0	2
2	7		8/6/2018	0	7		1	6
3	8		8/30/2018	4	1		1	0
4	7		9/1/2018	0	2		0	0
5	7	Patle	7/12/2019	0	1		1	0
6	3		7/12/2019	0	1		0	1
7	7	Patle	7/13/2019	2	1		1	0
8	7	Bakhre	7/1/2022	0	1	1200000	1	0
9	2	Tekanpur	7/23/2023	0	0		0	0
Total				**6**	**21**	**1,200,000**	**5**	**9**

Table 5.2: Fire Incidences (Nepal Disaster Risk Reduction Portal, 2023)

S.No.	Ward No.	Incident Place	Incident Date	Total Death	Affected Family	Estimated Loss	Private House Fully Damaged	Private House Partially Damaged	Cattles Loss	Displaced Shed
1	6		12/5/2017	0	1	250000	1	0	0	0
2	7		3/8/2018	0	1		0	0	0	0
3	4		4/25/2018	0	1	150000	1	0	3	1
4	1		10/13/2018	0	1	500000	1	0	6	0
5	7		12/3/2018	0	1	570000	1	0	0	0
6	2		1/28/2019	0	1		0	0	0	0
7	6		2/5/2019	0	1	155000	0	1	0	0
8	2		4/1/2019	0	1		0	0	0	0
9	6	Shreechahur	4/2/2020	0	3	6017000	0	3	0	0
10	6	Nayaban	2/6/2021	1	1		0	0	0	0
11	6	Nawaban	2/24/2021	0	1	200000	1	0	0	0
12	4	dhad	4/25/2021	0	1	300000	0	0	0	1
13	7	Patle	12/23/2021	0	1		0	0	0	1
14	6	shrechaur	1/26/2022	0	1	2000000	0	0	0	0
15	1	Kuntadevi	12/14/2022	0	1	8000000	0	0	0	0
16	2	Tekanpur	6/17/2023	0	1	150000	0	0	0	0
17	4	Harkapur	6/18/2023	0	1	500000	1	0	0	0
Total				**1**	**19**	**18,792,000**	**6**	**4**	**9**	**3**

6. Agriculture Sector

Table 6.1: Major crops cultivated in Molung Rural Municipality (Source: AKC Okhaldhunga, 2079. Agriculture Knowledge Center Okhaldhunga)

S No	Crop Type	Crops
1	Cereals	Maize, millet, rice , wheat, buckwheat
2	Pulses	Black gram, Lentil, White gram, Horse gram, cowpea, rice bean
3	Oilseed	Mustard, sesame
4	Vegetables	Cabbage, Cauliflower, Broccoli, Broad Leaf Mustard (Rayo), Potato, tomato, capsicum, chilli, tomato, brinjal, Beans, cucurbits (Cucumber, sponge gourd, snake gourd, bitter gourd, Ash gourd, chayote etc) coriander, Fenugreek, onion, garlic
5	Fruits	Citrus, mango, banana, pineapple, Jackfruit, pear, peach, plum, guava, papaya, litchi, avocado
6	Cash crops	Sugarcane, coffee, Avocado
7	Spice crops	Large cardamom, ginger, turmeric, onion, garlic,
8	Indigenous crops	Junelo, millet, Kaguno, buckwheat

Table 6.2**:** Cropping system in Molung Rural Municipality.

S No	Cropping system		Mix cropping	
	Khet land	Bari land	Khet land	Bari land
1	Rice -wheat-maize	Maize-millet-buckwheat	Wheat+ Tori	Maize+ beans
2	Rice-tori-maize	Maize-potato-fallow	Wheat+ pea	Maize + Potato
3	Rice-wheat-rice	Maize-Wheat-Fallow	Potato + radish	Millet+ Radish+ Rayo
4	Rice-Potato-maize	Maize-Buckwheat-Fallow		Millet + Black gram
5	Rice-buckwheat-maize	Potato-Fallow-Fallow		Maize + millet
6	Rice-vegetables-maize	Maize-Black gram-Fallow		
7	Rice-fallow-maize	Maize-Soybean-Fallow		
8	Rice-fallow-rice	Maize-vegetables-Fallow		

Source: AKC, Okhaldhunga, 2079. Annual Progress Report and Statistics Pustika 2078/79

Table 6.3: Crop calendar for various crops in Molung Rural Municipality of Okhaldhunga district.

Crop	Jan	Feb	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec
Rice												
Maize												
Millet												
Wheat												
Potato												
Winter vegetables												
Summer vegetables												
Pulses												
Oilseeds												
Planting /sowing time:						Harvesting Time:						

Table 6.4: Recommended domains and special features of major climate resilient crop varieties in Nepal (Source: NARC Diary 2077 & Released and Promising Crop Varieties of Mountain Agriculture in Nepal (1959-2016).

Crop	Variety	Recommended Zone	Special Feature
Rice	Chandanath 1, Chandanath 3, Lekalidhan 1, Lekalidhan 3	High-hills	Cold tolerant
	Swarna sab 1, Saba Mansuli sab 1, Sworng sab 1	Terai and mid-hills	Flood tolerant
	Sukkhadhan 1, Sukkhadhan 2, Sukkhadhan 3, Sukkhadhan 4, Sukkhadhan 5	Terai and mid-hills	Drought tolerant
	Sukkhadhan 6, Bahuguni 1, Bahuguni 2	Terai and mid-hills	Drought and flood tolerant
	Makawanpur 1	Terai	Leaf Folder resistant
Maize	Mankamana 3, Ganesh 1, Shitala	Mid-hills	GLS resistant
	Deuti	Mid hills	Drought tolerant and Grey Leaf Spot (GLS) resistant
	Arun 2, Arun 3, Arun 4, Arun	6 High-hills and winter crop for Terai	Early maturity
	Khumal Hybrid 2	Mid-hills	winter crop for Terai
	Poshilomakai 1	Mid-hills (below 1,600 m)	Rich in protein
	Poshilomakai 2	Terai	(winter season)

Crop	Variety	Recommended Zone	Special Feature
Wheat	Bijaya	Terai, river basin and valley up to 500 meter	Tolerant to heat stress and blight resistant
	Gautam	Terai, river basin and valley up to 500 meter	Tolerant to eat stress
	Munal	Chyakhura Mid-hills and high-hills	Rust resistant
	Danfe	Mid and high hills	Blight resistant
	Tilottama	Terai	
Potato	JanakDev	Mid to high hills and winter crops for the kathmandu valley and Terai	Late blight resistant
	Khumalbikas	Mid-hills, to high-hills	
	Khumalujjwal, Khumal Rato 2		
	Terai Khumal Seto 1	Mid hills in autumn and high hill in summer season	
	Khumal Upahar	Terai to mid-hills	
Rapeseed	Lumle tori 1	Mid and high-hills	Drought tolerant
Amaranthus	Ratomarse, Ladimarse, Suntale latte	Mountain region (high and mid-hills)	Drought tolerant