



Report

Conduct Participatory Assessments of the Marin Watershed to Identify Integrated Climate Change Adaptation Options and Execution Strategies.

**Natural Resource Conservation Services
Pvt. Ltd., Minbhavan - 31, Kathmandu
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Executive Summary

Managing Watersheds for Enhanced Resilience of Communities to Climate Change in Nepal (MaWRiN), a six-year long project launched in 2024 aimed at enhancing the resilience of indigenous and local communities in the Marin Watershed, Sindhuli District. Supported by the Global Environment Facility (GEF) and implemented by the Ministry of Forests and Environment (MoFE) with technical assistance from WWF Nepal, the project integrates nature-based solutions (NbS) and participatory watershed management to address the growing impacts of climate change on ecosystems and livelihoods.

The Marin Watershed, spanning approximately 70,000 hectares, in 20 wards of four Rural/Municipalities of the district was identified as one of the most climate-vulnerable areas in Nepal due to frequent hazards such as landslides, floods, sedimentation, forest fires, droughts, and water scarcity. Within the watershed, the project specifically targets six highly exposed sub-watersheds—Dhungajor, Ghagar, Jalkeni Sakhauri, Kyan, Phulbari, and Simle -covering 14 wards across four municipalities. The watershed is home to over 78,814 people, with 69% belonging to Indigenous communities and 8% from Dalit groups, most of whom depend on subsistence agriculture and forest resources for their day-to-day livelihoods.

A participatory assessment was carried out from May to June 2025 to identify vulnerable sites and communities and recommend integrated adaptation activities and executing strategies to enhance the ecosystem and community resilience to climate change impacts. The assessment applied a range of participatory and inclusive approaches like focused group discussions, key informant interview, participatory resource/social mapping, field observations, GIS-based mapping, and review of literature. The methodology emphasized stakeholder participation, contextual relevance, and alignment with national river basin management strategies and climate adaptation frameworks. Both qualitative and quantitative data were collected from primary and secondary sources. Primary data were collected from the field study and the secondary data were collected from reports of sources such as district level government agencies, Palika profiles and plans, and reports of National Statistics Office. The assessment adopted multiple methodologies social and geographic information systems. The assessment also recognized the diversity among the targeted population along the axis of differentials in terms of gender, caste and ethnicity, proximity to vulnerable sites and market centers etc. and efforts were made to capture the diversity.

Accordingly, the study team consulted project management team, local governments and their ward offices, relevant government officials (forestry, agriculture, livestock, soil and watershed management, irrigation), Nepal Red Cross Society, NGO Federation, Sub-watershed Coordination Committees, resource governance institutions (FECOFUN, NEFIN) and other community-based organizations (e.g. CFUGs, LFUGs, and women's groups). In total, over 488 individuals participated in 19 FGDs, including women, indigenous groups, and ward representatives. Further, the KIIs were conducted with 14 officials from government and non-government offices who are

directly involved in watershed management in Marin. In addition, project management unit level, municipal and district-level validation workshops were conducted in order for sharing the field assessment finding as part of validation and garnering their valuable feedback to align with the district level priorities, plan and policies.

Key findings reveal that agriculture and livestock remain central to livelihoods but are increasingly threatened by crop loss from wildlife, pest outbreaks, declining soil fertility, drought and erratic rainfall. Use of chemical inputs has intensified while indigenous crops and biodiversity have declined. Significant male outmigration has led to a feminization of agriculture, with over 41% of households reporting absentee family members.

Biophysical assessments show that forests cover over 70% of the watershed, with 143 active Community Forest User Groups (CFUGs) playing vital roles in forest governance and forest fire control. Over the years, forest cover has increased. Pressure on forests, especially related to collection of firewood and fodder, has declined over the years as people have started using LPG for cooking and the reduction in animal husbandry. However, pressures from infrastructure construction, grazing in some areas, forest fires, flash flood and soil erosion remain high. Water sources, including springs, streams, and rivers, have shown reduced discharge and quality degradation, affecting both drinking and irrigation needs and ecosystem services. Land cutting, deposition by the *Khahare khola* have increased threatening have increased, thereby posing threats to settlements and agricultural system. Aquatic biodiversity has severely declined due to owing to destructive fishing practices, reduction in water discharge, agricultural runoff, and waste disposal along the water courses.

The study also identified multiple hazards -including landslides, riverbank cutting, sedimentation, and forest fires—exacerbated by fragile geology, poor land use practices, and climate variability. The waste management situation is worsening due to population clustering and changing consumption habits.

Despite these challenges, the watershed presents significant opportunities. The Madan Bhandari Highway and proximity to BP Highway provide improved market access in Kathmandu and cities located in the Terai region. Strong local institutions, particularly CFUGs and responsive local governments, offer a foundation for coordinated climate action. The Sunkoshi–Marin water diversion project is expected to enhance water availability and protection from river erosion, enhancing long-term resilience.

The assessment identified site-specific climate adaptation measures focusing on women, poor, marginalized groups like Hayu, Majhi, Danuwar, Dalits, people with disability and vulnerable ecosystems. Priority actions include promoting Nature-based Solutions (Nbs), strengthening local

institutions, scaling up climate-resilient livelihoods, improving forest and water governance, and leveraging infrastructure investments to build sustainable and climate-resilient livelihoods.

The assessment also identified potential demonstration sites in each sub-watershed considering the factors like socio-economic and climate-induced vulnerability, potential for implementing integrated watershed management practices, upstream-downstream linkages.

The study also proposed execution strategy for effective implementation of the project. These strategies include spatial prioritization of conservation activities in upstream areas; proper balancing of 'hardware/software' components; focusing on activities with multiplier effects; promotion of entrepreneurship; institutional strengthening of sub-watershed level coordination committee; and strengthening of watershed champions among others. Overall, strengthening of ownership by the Local Governments is overarching strategy.

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1. Introduction

1.1 Background

The Government of Nepal initiated a six- year long project ‘Managing Watersheds for Enhanced Resilience of Communities to Climate Change in Nepal (MaWRiN)’ in 2024 with the aim of increasing climate resilience of indigenous and local communities in the Maru watershed by promoting nature-based solutions that reduce vulnerability, enhance adaptive capacity, and build sustainable livelihoods. It aims to strengthen the resilience of local and Indigenous communities who are highly dependent on subsistence farming and forest resources.

The project was designed in response to climate change risks identified during a preliminary vulnerability assessment. Based on indicators such as landslides, floods, forest fires, water scarcity, and erosion, the Maru Watershed in Sindhuli District was identified as one of the most vulnerable regions in the preliminary study. The project is being implemented with the financial support from the Global Environment Facility (GEF) and technical support from WWF Nepal. The project is executed by the Federal Ministry of Forests and Environment (MoFE) with Ministry of Forest and Environment, Bagmati as the executing partner aligning with the national climate adaptation frameworks and priorities.

The project has 3 components: Component 1 focuses on creating an enabling environment for climate change and adaptation mainstreaming through development of capacity of the municipalities and other key local agencies to assess and understand climate risks and vulnerabilities. and catalyze an innovative approach for integrated watershed management; (ii) Component 2 focuses on integrating climate change impacts and adaptation measures into watershed planning and management. It promotes the implementation of nature-based solutions (NbS) to reduce the impacts of natural disasters enhance agriculture productivity and resilience, support livelihood diversification and strengthen the adaptive capacity of vulnerable communities; and (iii) Component 3 focuses on increasing knowledge and learning for sustainability and replication while ensuring monitoring and evaluation for adaptive management of the project.

As the project is at initial stage of implementation, the executing agency wanted to conduct participatory assessment of the Maru watershed to identify integrated climate change adaptation options and their execution strategies. A study was conducted in May and June of 2025 in six sub-watersheds, namely Dhungajor, Ghagar, Jalkeni Sakhari, Kyan, Phulbari, and Simale of Maru watershed to identify the vulnerable areas and integrated adaptation options/intervention in participation with the local communities, government and non-government line agencies. This report presents the outcome of this study.

1.2. Objectives of the assignment

The objective of this assignment is to conduct participatory consultations and assessments with stakeholders to identify integrated adaptation activities and execution strategies within the priority

sub-watersheds of the Marin watershed. The objectives of the assignment are further elaborated in the scope of the assignment.

1.3 Scope

This assessment focuses on identifying integrated climate change adaptation options and execution strategies for the Marin Watershed. The study covered six sub-watersheds—Simle, Dhungajor, Ghaghar, Phulbari, Kyan, and Jalkeni Sakhauri—spread across 14 wards of four municipalities: Ghyanglekh Rural Municipality, Hariharpurgadhi Rural Municipality, Marin Rural Municipality, and Kamalamai Municipality.

The assessment is structured to achieve the following:

- Identify climate-vulnerable and socio-ecologically critical areas through participatory mapping and GIS analysis.
- Conduct comprehensive field-based assessments, including field observations, participatory consultations, Key Informant Interviews (KIIs), and Focus Group Discussions (FGDs).
- Propose integrated adaptation activities tailored to local ecological and socio-economic contexts, including nature-based solutions (NbS).
- Recommend demonstration sites in each sub-watershed for piloting adaptation interventions.
- Develop an execution strategy that is inclusive, feasible, and based on existing local institutional capacities and coordination mechanisms.
- Document the findings with detailed spatial references using GPS and GIS tools to aid future planning and monitoring efforts.

1.4 Overview of the Project

1.4.1 Objective of the project

The Managing Watersheds for Enhanced Resilience of Communities to Climate Change in Nepal (MaWRiN) project is a six-year initiative (15 August 2024 to 14 August 2030) designed to enhance the adaptive capacity of vulnerable communities within the Marin Watershed, located in Sindhuli District, through Livelihood diversification and nature-based solutions.

At the federal level, the project is executed by the Ministry of Forests and Environment (MoFE), Government of Nepal. At the provincial level, the implementation is led by the Ministry of Forests and Environment, Bagmati Province. WWF Nepal serves as the implementing agency responsible for technical support, coordination, and field-level execution.

Spanning approximately 70,000 hectares, the project targets six priority catchments within the Marin Watershed—Ghagar sub-watershed, Kyan sub-watershed, Phulbari sub-watershed, Dhungajor sub-watershed, Jalkeni Sakhauri sub-watershed, and Simle sub-watershed—which

were selected based on their high exposure to climate-induced hazards and the socio-economic vulnerability of the communities. The MaWRiN project is structured around three core components: i) creating an enabling environment for climate adaptation, ii) implementing on-the-ground nature-based solutions and livelihood diversification, and iii) enhancing knowledge generation and replication. The initiative is expected to improve forest and watershed management across 29,000 hectares, directly benefit over 3,860 households, and enhance water and livelihood resilience for more than 1,000 Indigenous households.

1.4.2 Project area

The project area is the Marin watershed, which extends over approximately 70,000 hectares in the mid-western part of Sindhuli District, located in Bagmati Province of central Nepal. Geographically, it extends from 85.503824 E to 85.958326 E longitude and 27.136513 N to 27.384487 N latitude. The watershed encompasses the two major river systems—Marin and Kyan—and includes a network of smaller catchments, rivulets, and seasonal streams. The Marin River originates from the fragile and erosion-prone Churia hills and flows through four local government units: Ghyanglekh Rural Municipality, Hariharpurgadhi Rural Municipality, Kamalamai Municipality, and Marin Rural Municipality.

The watershed covers a total of 20 administrative wards spread across these four municipalities. According to the most recent population data, the area is home to 78,814 individuals, including 38,360 males and 40,454 females. The demographic composition of the watershed is diverse, with approximately 68.5 percent of the population belonging to indigenous communities such as Tamang, Magar, Newar, Danuwar, and Majhi. While Hayu, Danuwar and Majhi are the most vulnerable indigenous groups among others. In addition, around 8.28 percent of the population comprises Dalit communities, including Kami, Sarki and Damai/Dholi, who have historically faced socio-economic marginalization.

The livelihoods of most residents are closely tied to natural resources, particularly subsistence agriculture and small-scale livestock rearing. However, the region is highly vulnerable to climate-induced hazards due to a combination of physical, environmental, and socio-economic factors. These include unstable slopes, increasingly erratic rainfall patterns, deforestation, soil degradation, and limited infrastructure. The region frequently experiences landslides, floods, forest fires, and droughts, all of which are being intensified by the effects of climate change. The high poverty rate estimated at 43 percent further exacerbates the vulnerability of local communities and limits their capacity to adapt to changing environmental conditions. The Project is being implemented against this context.

2. Methodology

The assessment of the Marin Watershed was conducted in a participatory and inclusive approach consulting project management team, relevant stakeholders like Divisional Forest Offices, Soil and Watershed Management Office, Agriculture Development Office, Livestock Development Office, Local Governments and their Ward Offices, Sub-watershed Coordination Committees and other community-based organizations (e.g. CFGUs, LHFGs, and women's groups). The aim of engaging with the key stakeholders in the process was to develop sense of shared and mutual ownership and to garner their support in implementation.

The methodology emphasized stakeholder participation, contextual relevance, and alignment with national river basin management strategies and climate adaptation frameworks. Both qualitative and quantitative data were collected from primary and secondary sources. Primary data were collected from the field study and the Secondary data were collected from reports of sources such as district level government agencies, Palika profiles and plans, reports of National Statistics Office. The assessment adopted multiple methodologies social and geographic information systems. The assessment also recognized the diversity among the targeted population along the axis of differential such as gender, caste and ethnicity, proximity to vulnerable sites and market centers etc. and efforts were made to capture the diversity.

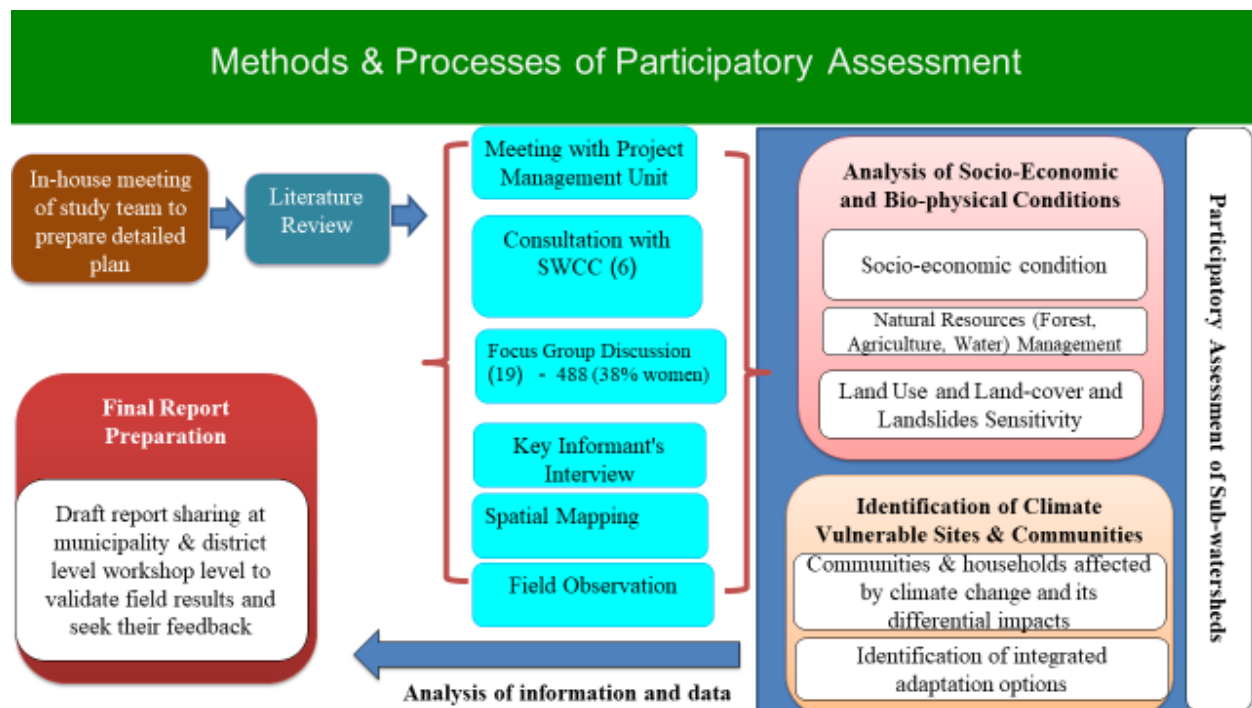


Figure 1 Methodological Framework

2.1 Preparatory phase

2.1.1 In-house workshop

The preparatory phase laid the foundation for effective field study. Initial activities included in-house workshop of the study team to spell out the roles, responsibilities, develop methodological framework, prepare tools (such as checklists for FGDs and KII), and preparing a detailed execution plan.

2.1.2 Literature review

A thorough literature review was undertaken to compile and analyze national and sub-national policies, strategies, legal frameworks, and previous research related to climate change, adaptive watershed management, and vulnerability assessment. This review helped identify policy gaps, synergies, and opportunities for alignment with the MaWRiN project. The list of key documents reviewed is attached at *Annex 6*.

Likewise, we also reviewed the Local Governments' profiles, plans and other relevant reports published by each local government and the sectoral offices within the project area. Furthermore, report of National Statistics Office was reviewed to analyse the demographic trends in the project wards. Likewise, remote and in person consultations were organized with the coordinators of Sub-watershed Coordination Committees for identifying the potential sites for community consultations before initiating the field study.

2.1.3 Inception meeting with PMU

Online consultation meeting was held with the Project Management Unit (PMU) to ensure shared understanding of the project scope, expectations, and deliverables. General methodology, issues in the field, and general timeline for field study was also discussed in the meeting. Further, the study team regularly coordinated with the Team Leader, Project Officer, Communication, Monitoring, Evaluation and Learning Officer, Project Associates to update the progress and their support for coordination with the stakeholders.

2.2 Field study

Field study was conducted in six priority sub-watersheds in the Marin Watershed. It was conducted in two phases. The first phase was conducted from May 22 to May 30 that included consultation with the PMU, consultation with communities and the government officials. The second phase of the field study was conducted from June 21 to 24 to share findings of the field assessments of the first phase with the Local governments, and District level stakeholders including District Coordination Committee. The second phase of the study helped to validate the information and analysis of the first phase and generate additional information/ suggestions that helped to enrich the assessment carried out in the first phase.

A team of technical experts, as proposed in the proposal, conducted the field study in all sub-watersheds in order to collecting information, observation and triangulate the field context. The sites for community consultations within the sub-watersheds were identified considering factors like geographical coverage and representation of different settlements, vulnerability, and ethnic representation in consultation with the PMU and Coordinators of the Sub-watershed Coordination Committee. A range of participatory and spatial tools like Focus Group Discussion (FGD), Key Informant Interviews (KIIS), community/social resource and hazard mapping, and transect walk were applied to map out socio-economic and bio-physical conditions, assessment of climate induced and other hazards, assessment of climate vulnerable sites and communities. The field assessment focused on identifying key vulnerabilities, including areas affected by drought, flood, landslides, forest fires, and human wildlife conflict. These observations aimed to inform the identification and prioritization of site-specific adaptation measures to address hazards such as landslides, floods, soil erosion and forest fires at the sub-watershed level.

Satellite images were used as base map for social and hazard mapping. The consultation meetings also identified integrated adaptation activities, geographic coordinates of key intervention sites and communities. Likewise, the field assessment also helped to identify the demonstration sites in each sub-watershed area in consultation with the sub-watershed coordination committees.

2.2.1 Key Informant Interviews (KIIs)

KIIs were conducted as a qualitative method to gather in-depth insights from individuals with first-hand knowledge of watershed management, local socio-economic conditions, customary practices, and the impacts of climate change on vulnerable communities. They were conducted with the Government officials (Forestry, Agriculture, and Veterinary), Ward Chairpersons, officials of resource governance community organizations like FECOFUN and NEFIN. The list of officials consulted through KII is provided in the *Annex 7*. These interviews provided valuable contextual understanding that complemented the findings from participatory assessments and field observations. For example, the DFO of Marin highlighted how the use of drone technology and coordination with the CFUGs helped in managing forest fire last year, i.e. Fiscal year (FY) 2081-82.

2.2.2 Focus Group Discussion

A total of 19 FGDs were conducted in these six sub-watersheds of the Marin Watershed to gather community perspectives on watershed conservation and climate change adaptation (*Annex 8*). The specific sites for FGDs were identified in consultation with Sub-watershed Management Committees taking into account factors like representation of physiographic and ethnic diversity, and coverage of the sub-watershed. These discussions were attended by representatives of CFUGs and LFUGs, women's groups, farmers groups, ward officials (including chairpersons), Water User Groups among others. In total, 488 participants participated in these FGDs. Of the total participants, 185 (38%) participants were women and 303 (62%) were male. In terms of economic

conditions, majority of participants (87%) were from middle class and 13% were from poor strata. In terms of caste and ethnicity, majority of participants (75.4%) were from Indigenous ethnic groups, while 6.56% were from Dalits communities and remaining 17.4% were from Brahmin and Chhetri communities. Most importantly, the Ward Chairpersons and members also participated in most of the FGDs that immensely helped to gather information regarding the given tasks and also contributing to validation. The discussion focused on general social features, conditions of biophysical resources (forest, water sources, community land, and biodiversity), agricultural system, livelihood means, hazards and vulnerabilities, resource governance systems, major challenges, future priorities and strategies.



Photo 1 Focus Group Discussion in Ghagar Sub-watershed, Kamalamai Municipality at Nepane on 25 May 2025



Photo 2 Focus Group Discussion in Simle Sub-watershed, Ghyanglekh Rural Municipality -1 Amale on 30 May 2025

2.2.3 Participatory Mapping of the Sub-watershed

Participatory mapping sessions were organized in consultation with key knowledgeable people and participants of the FGDs. Similarly, the information generated through mapping were validated by transect walks, field observations, and consultation with the Sub-watershed Coordination Committee. Satellite Images were used as basemap for participatory mapping. The mapping exercise identified biophysical features (such as forests, streams, ponds), social features (major settlements, locality of vulnerable groups), vulnerable sites (landslide, river cutting, flooding, gullies), nature-based solutions/adaptation interventions (embankment, checkdams, irrigation canals, conservation ponds etc.).



Photo 3 (left) and 4 (right): Participatory Mapping Sessions in Khayarsal of Phulbari Sub-watershed (left) and Barun of Kyan Sub-watershed (right)

Through these sessions, specific areas of ecological and social vulnerability; and potential intervention sites were identified, providing a solid foundation for planning and prioritizing integrated adaptation activities. The resulting maps served not only as visual tools for guiding spatial planning but also as references for future monitoring and evaluation, enabling stakeholders to track environmental changes and adjust strategies as needed.

2.2.4 Field Observation

The technical team conducted field observations in the sub-watersheds, usually before or after the Focus Group Discussions, together with some participants of the FGDs. The observations covered areas like vulnerable sites (river cutting, landslide prone areas), conservation activities like ponds, water sources protection etc. The team also conducted transact walk.



Photo 6: Field observation in Ghaghar sub-watershed



Photo 7: Observation of water conservation practices

2.2.5 Municipal and District Level Workshops

The study team conducted 4 events of municipal level workshops and 1 event of district level workshop from June 21 to 24 in order for sharing the findings of field assessments. Altogether 88 people including 13 (15%) females participated in these workshops. In the **municipality level workshop** Mayors, Deputy Mayors, Ward Chairs, Ward members, SWC Coordinators and

Members including key officials of local governments, representatives from the PMU had participated. Likewise, in the *district level workshop*, DCC Chairperson, Government officials from Forestry, Agriculture, and Veterinary, Marin Diversion Irrigation Project, Ward Chairpersons, SWC Coordinators, Chairpersons from Nepal Red Cross Society, NGO Federation and NEFIN had actively participated. The Municipal and District Level Workshops greatly helped to validate the information and analysis of the first phase. In the meanwhile, they also provided additional information/ suggestions that helped to enrich the assessment carried out in the first phase.



2.3 Data Analysis

Following the completion of field study, the study team conducted a detailed analysis of the findings to generate a comprehensive understanding of the current state of the Marin Watershed and its sub-watersheds. This phase involved the systematic synthesis and amalgamation of literature reviews, stakeholder inputs, participatory assessment of field, and spatial analysis outputs.

Qualitative data from KIIs and FGDs were analyzed thematically to identify recurring concerns, community priorities, socio-cultural dynamics, and locally relevant adaptation options. These inputs provided critical insight into the lived experiences of marginalized indigenous communities, women, and other vulnerable groups, enabling a contextualized understanding of climate-related vulnerabilities, differential impacts of climate change and resource governance issues. Quantitative data from structured field observations and secondary sources were assessed to examine trends in land use, forest degradation, hazard exposure, water source depletion, and socio-economic indicators. Data were collected using checklists and semi-structured questionnaires, and the use of GPS-enabled devices allowed for accurate geo-referencing of critical sites such as landslide-prone areas, degraded forests, erosion-prone riverbanks, and potential demonstration sites.

Based on the information from participatory resource mapping done during community consultation, Geographic Information System (GIS) mapping was undertaken across the Marin Watershed. The mapping was carried out using topographic base maps, Google Earth images and various thematic GIS layers, with updated inputs based on the current field situation.

The GIS mapping aimed to identify and visualize key biophysical and socio-environmental features relevant to climate adaptation. Specific geospatial data were collected and recorded during field visits, including the coordinates of:

- Hazard-prone areas such as landslides, gullies, flood-prone stream/riverbanks, and soil erosion zones
- Area susceptible for forest fires, degraded forest patches and critical water sources and water bodies facing seasonal drying
- Wetland ecosystems, and ecologically significant areas
- Agricultural and horticultural production pockets with high potential for climate-resilient farming
- Locations with tourism and livelihood development potential

GIS-based spatial analysis played a key role in visualizing watershed conditions and prioritizing intervention areas. Maps were generated to illustrate land degradation, vulnerable communities, hazard prone zones, and infrastructure networks. Ground-truthing exercises were carried out to verify spatial data and ensure the accuracy of mapped outputs.

The analysis further identified key environmental threats—such as recurrent landslides, flooding areas, forest areas with frequent fires incidences, grazing areas, deforestation, and water scarcity—as well as socio-economic challenges, including livelihood vulnerability, limited access to services, and high dependency on natural resources. These findings informed the selection of site-specific adaptation measures and supported the development of an evidence-based and localized implementation strategy. The statistical analysis was conducted to examine patterns and correlations, particularly in relation to land use change, climate exposure, and resource availability.

To enhance clarity and usability, the findings were compiled and presented using a combination of tables, and GIS-based maps. These visual and analytical tools support transparent communication of results and are intended to inform future planning, monitoring, and decision-making by stakeholders at the local, provincial, and national levels. The final report offers a set of evidence-based recommendations for integrated adaptation options, emphasizing the integration of sustainable watershed management with nature-based solutions and community-driven adaptation strategies to reduce differential impacts of climate vulnerability and enhance the resilience of ecosystems and livelihoods within the Marin Watershed.

2.4 Limitation

The assessment was conducted within a limited timeframe, and it coincided with the important agricultural activities progressing in the watershed. Agricultural activities like seed sowing and harvesting of winter maize and weeding of summer maize were in the peak and this restricted the wider participation of the people in the community consultations. The consultant team also could visit the limited number of sites for conducting community consultations given the time limit. Despite concerted efforts to ensure inclusive participation, certain marginalized groups such as women, Dalits, and minority ethnic communities had limited representation in some FGDs, because of short notice as well as peak agriculture season. However, efforts were made to make the assessment comprehensive and mitigate the effects of limitations.

3. Result and Discussion

3.1 Assessment of the Marin watershed

3.1.1 Demography

Population and related features have been assessed based on the census of 2011 and 2021. Although the watershed covers only part of the wards in some of the wards, population of the whole ward has been included for analysis as that is the smallest spatial unit for census reporting. Similarly, two of the wards fall in two sub-watersheds: Ward number 1 of Kamalamai Municipality falls in Dhungajor and Ghangar sub-watersheds, and Ward no 5 of Marin Rural Municipality falls in Ghagar and Phulbari sub-watersheds. Altogether, the watershed falls in 20 wards of four rural/municipalities.

Total population of the wards where the watershed lies is 78,814 (male 38,360 and female 40,454) living in 17844 households with an average household size of 4.42. The average household size has declined from 5.38 in 2011. The annual population growth rate is 0.37 which is less than the national average of 0.93. Out of the 20 wards within the watershed, 13 wards experienced negative population growth rate.

In the case of priority six sub-watersheds, which have been identified as priority sub-watersheds for project implementation, there are 14 wards. The total population in these wards is 56,982 (male 27,673, and female 29,309) living in 12,763 households, with an average household size of 4.46. The average household size has declined from 5.43 in 2011. The average annual population growth rate is 0.45 which is much lower than the national average of 0.93. The population growth rate ranges from - 2.36 in Hariharpurgadhi- 5 to 3.57 in Kamalamai-4. Out of the total 14 wards in the priority sub-watersheds, 10 wards have negative population growth rate. This is also related to outmigration of people for employment. The average sex ratio in these wards is 94.42, which is slightly less than the national average of 95.59. The sex ratio ranges from 89.14 in Hariharpurgadhi-4 to 101.73 in Marin-2. Excepting three wards, all the wards have recorded increase in sex ratio in the last inter-census period. The low sex ratio is also attributed to migration of male for foreign employment. The low sex ratio has implication on added responsibility for women in agriculture and natural resource management.

People migrating for employment is an important social and economic phenomenon happening in the country and in the watershed. Migration of people is reflected in the absentee population reported in the census report. Out of a total 12,763 households in these priority sub-watersheds wards, 5,279 (41.36%) households have absent family members. The percentage of households with absentee population ranges from 23.46% in Kamalamai-1 to 71.75% in Hariharpurgadhi- 6. However, in terms of number of people being absent, a total of 11,587 people (20.33% of total) is absent. Out of the total absentee population, 7,275 (62.63%) are male and 4,312 (37.37%) are female. The absentee population includes both those being within the country and outside the country. A total of 2,255 (17.67%) households has family members abroad.

The major ethnic groups residing in the watershed are Tamang, Magar, Brahman, Chhetri, Danuwar, Majhi, and Newar. Janajatis account for about 69% of the population. Endangered ethnic group Hayu and Danuwar also reside in the Watershed. The distribution of these ethnic groups within the watershed has been assessed and visually represented in the map presented in *Annex 2*.

3.1.2 Livelihood

Agriculture is the mainstay for the overwhelming majority of the people in the watershed. People follow mixed- farming systems comprising crop production and animal husbandry. The major crops grown are paddy and maize in the lower-elevation plain area having irrigation facility. In the upper catchment areas, maize and finger millet are grown as rain-fed crops. The extent of finger millet cultivation has also declined. Other crops grown are mustard, pulses, and vegetables. In the areas closer to highway, people have begun growing vegetables for market. However, commercial vegetable production is still at initial phase. In the last decade, people have been increasingly growing maize as winter crop in place of earlier-practiced spring maize. The winter maize is grown in the area with irrigation facility. Usually, imported hybrid seeds are used for winter maize and local varieties are grown in spring season. Shifting to cultivating maize in winter is an adaptation measure to the problem of increased pest infestation in spring maize.

People grow fruits like mangoes, litchi, banana, papaya, jackfruit, pineapple, and citrus. The fruits are not grown commercially, though support household income. People in the recent past have started riverbed farming in along the banks of Marin and Kyan in smaller scale. They grow mostly cucurbits in the river-bed. The agricultural biodiversity has declined over the years. People reported that in the past they used to grow crops like sorghum (*Junelo*), fox tail millet (*Kaguno*), buckwheat (*Phapar*), horse gram (*Gahat*), rice bean (*Masyang*), taro (*Pindalu*), niger (*Philunge*), sweet potato (*Sakharkhanda*) etc. However, their cultivation has greatly reduced. Similarly, number of local varieties of major crops like paddy and maize are also lost. In the past, people used to practice slash and burn agriculture (*Khoriya*) and they used to grow minor crops in Khoriya. However, Khoriya cultivation is not practiced these days and many of these crops are not cultivated anymore.

Over the years, the use of chemicals in agriculture has increased. People invariably used chemical fertilizers in paddy, maize, and vegetables. However, chemical fertilizer is not used or used in lesser quantity for finger millet. As the number of animals kept has decreased over the years availability of manure has also declined proportionately. The use of insecticides and fungicides had been in practice for long. However, the use of herbicides has also become common practice in last 10 years or so. People have reported the adverse effects of increasing use of chemicals on soil health and water quality. Soil compactness has increased and soil organisms like earthworm have drastically decreased. The agricultural runoff also affects aquatic life.

The use of small agricultural machineries for ploughing and threshing of paddy is in practice especially in the plain area. However, there is a high potential for expanding and intensifying use of machineries, especially in the context of agricultural labor force. Use of pump sets for irrigation has also increased in the recent past. Since, women constitute the major labor force, especially in the context of increasing migration of male for foreign employment, women-friendly agricultural tools would support them to save their time and energy thereby enhance their work efficiency.

Another important challenge for crop production throughout the watershed is crop damage by wildlife. The common Wildlife causing crop damage are Monkey, Wild boar, Porcupine, Deer, Parrots, and Peacock. The type of animal causing the damage varies in different places. In some areas Monkeys are the principal damage causing animals and in other areas it is Wild boar. Settlements closer to the community forests are affected more. In some areas (as in Kyan) people grow turmeric as mitigatory measure against Monkey. Other challenges reported in crop production are unreliable availability of fertilizers, availability of suitable seeds, changing climatic patterns (such as long dry- spell), increased incidence of pests, declining soil fertility, increased dependance on external inputs which is unreliable, and marketing of produces.

Livestock production is an integral part of the farming system. The common livestock type are goat, cattle, buffaloes, pig, and poultry. Although people of all ethnic groups keep goat, cattle, and buffaloes, usually Magars keep pigs. The number of cattle and buffaloes have decreased drastically over the years. Almost all households keep goat and they play an important role in supplementing household income. Both stall feeding and open grazing systems are in practice. Some CFUGs have controlled open grazing while others have allowed grazing (discussed more in sub-watershed assessment section). Even where open grazing is practiced, buffaloes are not grazed in the forest.



Photo 10: Goat farming

People collect fodder from the forest, especially when the fodder in the farmstead is not enough. People have begun cultivation of grasses like mendula, napier, rye, teosinte, stylo, berseem, broom grass in the recent past. However, the cultivation of grasses is at smaller scale and not done in the main crop fields. They also plant different fodder trees. Goat pens and cowsheds are of moderate type (with some improvement from the traditional types). The Ward Offices of Rural/Municipalities organize vaccination programs against PPR and Foot and Mouth Disease. The Artificial Insemination is done mostly for cows and buffaloes and the service is not available from the Palika Offices. Farmers usually go to Agro-vet centers for technical inputs.

There are a few poultry farm and fish ponds in the watershed. People sell milk, especially in the area closer to highway. Goats are important source of income for the households.

Foreign employment continues to be a key livelihood strategy in the sub-watershed. For many households, this constitutes an important livelihood means. People going for foreign employment has been increasing every year. The census of 2021 showed that percentage of households with absentee people is as much as 71 % in the watershed. Remittances received are vital in supporting household incomes, helping cover costs related to education, healthcare, housing, and daily consumption. However, this dependence on external income has also led to agricultural labor shortages.

3.1.3 Biophysical Resources

3.1.3.1 Forest

The forest area in the watershed accounts for more than 70% of the total area of the watershed. The type of forest in the watershed is sub-tropical and tropical with common tree species of Sal (*Shorea robusta*), Khayar (*Acacia catechu*), Sissoo (*Dalbergia sissoo*), Asana (*Terminalia tomentosa*), Karma (*Adina cordifolia*), Chilaune (*Schima wallichii*), Champ (*Michelia champaca*), Simal (*Bombax cieba*), Jamun (*Syzygium cumini*), Botdhangero (*Lagerstromia parviflora*), Ghangaru (*Pyracantha crenulata*) and bamboo (*Dendrocalamus spp.*). Local communities have reported a noticeable decline in native tree species like Sal (*Shorea robusta*) and Katus (*Castanopsis indica*). These forests provide essential resources such as timber, fodder, grasses, and leaf litter. However, reliance on forest mainly for fuelwood and grazing has decreased in recent years due to increased use of LPG and reduction in cattle numbers. Altogether there are 143 community forests in the watershed. Other non-timber forest products collected include bamboo shoots, fiddlehead ferns, and leaves of Sal etc. However, the scale of collection is small.

The common wildlife found in these forests are wild boar, Jackal, Monkey, Porcupines, Squirrel, Parrots, Peacocks and occasionally Leopard. Among these, wild boar, monkeys, porcupine, parrots and peacocks cause significant damage to crops like maize, rice, millets, fruits, and vegetables. Over the years, crop damage by wildlife especially monkey, wild boar, porcupine, and parrots has become one of the major problems for crop production.

3.1.3.2 Water Sources

The main rivers draining the watershed are Marin and Kyan with several tributaries. These several rivulets and creeks are listed in the assessment of sub-watersheds. There are also several ponds, springs in the watershed. These water sources provide water for drinking and irrigation to the communities. Some of the streams (described later in sub-watershed assessment) cause river cutting affecting the ecosystems. It was reported in the community consultation that the water discharge has declined over the years though the forest cover has increased. Several water sources have dried up.



Photo 11: Observation of Water Sources

Over the years, several factors such as increased use of chemicals in agriculture and resulting runoff, waste disposal along the water sources, decreased water discharge, river cutting/deposition, destructive fishing (like poisoning, large nets) has affected the aquatic biodiversity. People have reported that several species of fish like Thend, Katle, Gachhi Bam, Bagi etc. have greatly reduced. Similarly, population of other aquatic life crab, frogs have also declined. In the upstream areas like in Simle, where water quality is relatively good, *Paa* are found.

3.1.4 Hazards

The slope, weak and fragile geology, frequent and intense rainfall, sliding debris along with trees is major driver of multiple hazards such as soil erosion, landslides, flash flood, river cutting, sedimentation and inundation. The presence of loose and poorly consolidated soils, coupled with steep slopes and intense rainfall events, contributes to accelerated soil erosion risk, posing a threat to the landscape's stability. Furthermore, the sparse vegetation cover, often resulting from forest fires, over grazing, deforestation, illegal logging and improper land use practices, contributes to inadequate soil stabilization and increases surface runoff. The combination of these factors heightens the vulnerability of the upstream area to soil erosion, leading to the potential downstream transport of sediment, negatively impacting water quality, and increasing flood risks in the downstream of the river basin. Forest fire is one the hazard that is caused mainly by dried and fallen twigs/branches which is lit by passerby and grazers.



Photo 11: Sedimentation in Marin

In response, few Community Forest User Groups (CFUGs) in the area have recently invested in fire-fighting equipment, coordinating with the District Forest Office (DFO) and allocating

approximately 25% of their CFUG funds to enhance forest protection and management. Hailstorms and strong winds have caused significant damage to standing crops and fruit trees, while forest fires have become more frequent and severe during prolonged dry spells that will also trigger soil erosion in the sub-watersheds

Collectively, the communities are grappling with compounding environmental and climate-related risks that demand urgent attention through integrated risk reduction, forest protection, and agricultural resilience strategies.

3.1.5 Waste Management

Over the years, number of households have concentrated closer to roadhead and market centers and waste management is becoming a problem. Volume of waste generation is also increasing because of use of packaged material and changing consumption habits. Currently, solid waste is often disposed closer to water courses. This often pollutes the water sources affecting general environment and aquatic life. There are *Tol Bikas Samiti* in wards who take the responsibility of waste management. A concerted effort is required for proper waste management to improve the ecosystem health and socio-economic well-being.

3.1.6 Opportunities

The previous section described the challenges the communities and ecosystems facing in the sub-watershed. At the same time, there are opportunities which need to be cashed on. The Madan Bhandari highway passes through the watershed and several settlements are linked to the highway or are in close distance. This creates an opportunity for easier transport of agricultural inputs and marketing of products. People can easily access the agrovets located in market centers. In addition to the national highway, most of the settlements are linked to the roads (though some are seasonal). Similarly, the watershed is also quite close to BP highway. The proximity to highway provides linkages to major market centers in Tarai and Kathmandu.

Generally, the community level resource organizations, especially the CFUGs are effective and institutionally strong. They have updated the operational plans and functioning well. These vibrant institutions provide strong institutional base for launching resilience focused activities. The coordinated efforts by these CFUGs with the DFO in managing forest fire the last year provides an example of such potential. The good condition of forests, institutional arrangement, and easy reliable access provides an opportunity for initiating nature-based enterprises.

The Local Governments in the Watershed have shown strong ownership of the initiatives of the project. The conducive environment at the Palika government level is an important strength for project implementation. This should also help in leveraging resources for project activities and also creating synergy. In addition, other initiatives of national significance like President Chure Tarai Madhesh Conservation and Development are also working in the area.

Another important emerging issue in the watershed is diversion of water from Sunkoshi to Marin which will be completed in near future. This will increase the water availability especially along the Marin River. Also, the associated construction of embankment to protect the river banks will reduce the river cutting. This will have far reaching implications on regulating water flows and protecting the land, enhancing the livelihood and resilience of the people living closer the river.

3.2 Assessment of sub-watersheds

3.2.1 Simale Sub-watershed

The Simale sub-watershed falls entirely within Ward No. 1 of Ghyanglekh Rural Municipality. Encompassing an area of 2,675.80 hectares, the landscape ranges in elevation from 492 to 2,235 meters above sea level. The region is characterized by a dense network of rivers and streams, and forests cover approximately 65.68% of the total area.

3.2.1.1 Socio-economic conditions

3.2.1.1.1 Demographic characteristics

The demographic assessment for the Simale sub-watershed has also been conducted based on ward-level Census data. The total population in the sub-watershed is 2,060 (male 1,013 and female 1,047) with a total household of 444. The average household size is 4.64, which has declined from 5.45 in 2011. The average annual population growth rate is -0.93 in ward no. 1. The sex ratio is 96.75, showing an increase from 86.24 in 2011. The settlement is socially diverse, predominantly inhabited by Indigenous groups, where Tamang make up the majority, along with other groups such as Magar, Rai (Danuwar), Dalits, and Chhetri. The major settlements of Simale sub-watershed are: Simale, Byukti, Balchuada, Langdi, Koltar, Thalagaon, Haredanda, Shree Danda, Chharchhare, Lwange, Sukhachuli, Bhir Goan, Tuni Bhanjyang, Rajbas, Kattar, Maintar, Dhwanse Danda, Jyamire, Banjhakhet, and Jogitaar.

The migration has significantly shaped the area's social dynamics, which is evident in the Census-reported absentee population. Out of the total households in these three wards, 189 (42.57%) households have absentee member in the family. A total of 336 (16.31%) people are absent in these wards. Out of the total absentee population 66.86% are male and 32.14% are female. The figures of absentee population include both living within the country and abroad. Usually, the people migrated abroad are engaged in foreign employment. A total of 117 (26.35%) households have family member living abroad. Specifically, within-country absenteeism includes 9.77% males and 8.4% females, while abroad absenteeism includes 12.73% males and 1.91% females, making up 7.23% of the total population.

3.2.1.1.2 Agriculture and Livestock

The Simale sub-watershed remains predominantly dependent on agriculture as the principal source of livelihood. Households primarily cultivate crops such as rice, maize, millet, potatoes, mustard, and a variety of seasonal vegetables, largely for subsistence purposes. A limited number of farmers have recently begun engaging in commercial vegetable farming, reflecting a slow but emerging shift toward semi-commercial agricultural practices. Despite this gradual transformation, farmers face significant challenges, particularly related to inadequate irrigation facilities and increasing incidences of crop diseases and pest infestations. Irrigation support remains inconsistent and limited across the sub-watershed, affecting productivity, especially during dry seasons.

Livestock rearing constitutes an important complementary livelihood activity in the Simale sub-watershed. Households commonly rear goats, buffaloes, cows, oxen, and poultry, with most animals managed under open grazing systems. However, the population of cows and oxen has been gradually declining. In contrast, there has been a modest rise in commercial livestock farming—particularly of goats, buffaloes, and poultry, supported by improved forage varieties such as Mendula, Super Napier, and Jai, in addition to traditional grass species.

3.2.1.1.3 Institutions

The main local institutions in the Simale sub-watershed include Community Forest User Groups (CFUGs), Leasehold Forest User Groups (LFUGs), Community Development Committee, Water User Group and Women’s Groups. These institutions are central to natural resource management, community mobilization, and local development efforts, playing a crucial role in promoting participatory governance, social inclusion, and sustainable development within the sub-watershed.

3.2.1.2 Bio-physical

3.2.1.2.1 Land Use and Land Cover

Out of the total area, the forests make up the majority of the sub-watershed's land use and land cover (65.68%), followed by agriculture (18.96%), grassland (6.15%) and bush (6.10%).

Table 1 Land use land cover of Simale sub-watershed

Landuse/Landcover	Area (Ha)	Percentage (%)
Barren Land	14.05	0.52
Bush	163.21	6.10
Cliff	2.49	0.09
Agriculture	507.37	18.96
Forest	1757.48	65.68
Grass	164.62	6.15
Sand	55.23	2.06
Waterbody	11.36	0.42
Total	2675.80	100.00

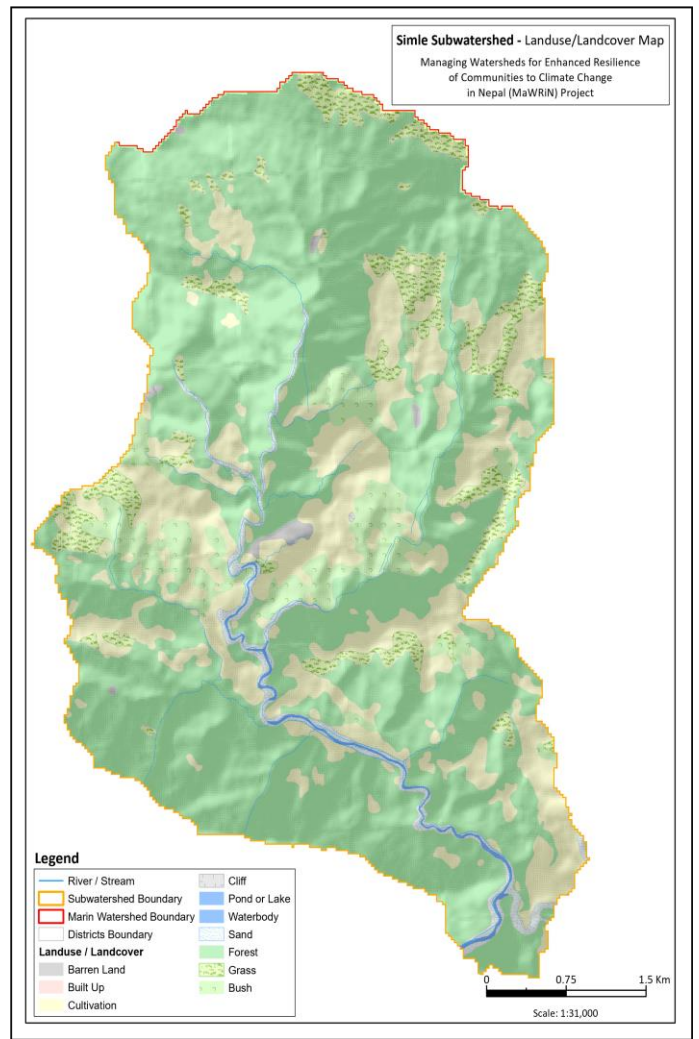


Figure 2 Land use and land cover map of Simale sub watershed

3.2.1.2.2 Forest and wildlife

The type of forest in the area is sub-tropical and tropical with common tree species of Sal (*Shorea robusta*), Chilaune (*Schima wallichii*), Katus (*Castanopsis indica*), Asna (*Terminalia tomentosa*), Uttis (*Alnus nepalensis*), and Simal (*Bombax ceiba*). Local communities have reported a noticeable decline in native tree species like Sal and Katus. Non-timber forest products (NTFPs), such as Kurilo (Asparagus), have been identified as having economic potential, though their current use remains largely for subsistence. In addition to their ecological significance, these forests support diverse wildlife; frequently reported species include Monkey, Parrot, Wild Boar, Porcupine, and Peacock.

There are national forests, community forests, leasehold forests and private under the jurisdiction of DFO. There is a total of 5 CFUGs (Ranibas, Chilinge (passive), Jhalkane, Laghuram, Ganesh

Dhunga) and 11 LFUGs (Kalika, Lalupate, Devisthan, Jungekhola, Hariyali, Bansbari, Laligurans, Pragatishil) within the sub-watershed. These forests provide essential resources such as timber, fodder, grasses, and leaf litter and they remain central to sustainable forest management and local livelihoods. Whereas, human-wildlife conflict is a persistent problem all over the sub-watershed, adding pressure to forest management and community well-being. However, the overall dependence on forests for energy has declined, with an estimated 60% of energy now coming from forest resources and the remaining 40% from LPG. This shift reflects changing livelihood dynamics, accompanied by a noticeable reduction in livestock numbers. Goats, cows, and buffaloes are still grazed in forest areas, which may pose long-term sustainability concerns if unmanaged. CFUGs in the area manage significant internal funds ranging from NPR 7 to 50 lakhs, which are used for both forest management and community development initiatives.

3.2.1.2.3 Water Sources

The major perennial streams identified in the area include Devisthan khola, Ghatte Khola, Gunte khola, Khani khola and Baraha khola which provide essential year-round water availability to surrounding communities. In addition to these perennial streams, the sub-watershed has other water resources including Kordhum, Aaral and drinking water resources like Lipe khola, Juke khola, Langdi khola, Bhimsen khola, and Jhakri khola.

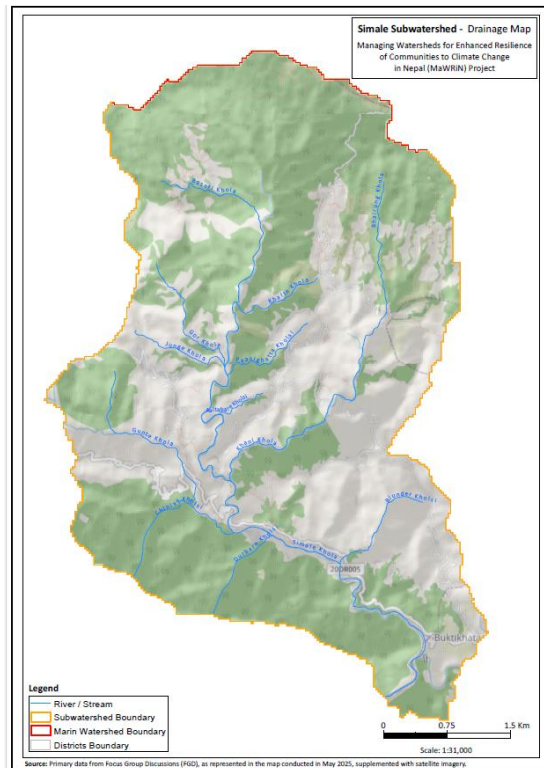


Figure 3 Streams, rivers of Simale sub watershed

3.2.1.3 Vulnerable and Priority Sites

3.2.13.1 Major Hazards

Based on a participatory assessment (including field observations and focused group discussions), along with GIS mapping, the primary hazards identified in the Simale sub-watershed landslides, riverbank cutting, floods, and forest fires.

Vulnerable and Priority Sites/Communities

- **Landslide-prone areas:** The proper sites like Chharchhare, Sirdanda Sukachuri, Bhirgaun, upper part (Shir) of Gunte khola, Bhairung khola, Bhairung khola shir, Amale, Khani khola have been suffering by landslides problem in the area. These events have severely damaged ecosystems, agricultural lands, and infrastructure.
- **Flood-prone and Riverbank cutting areas:** The confluence area nearby of Aaitbare Khosli, Kahni khola, Simale khola Jhalkhane CF, Bukkitar experience frequent flooding events that disrupt livelihoods and degrade natural systems. Agricultural lands and infrastructures (e.g. road) along these streams are especially at risk during heavy rainfall in upstream regions.
- **Forest fire-prone areas:** All forested and community forest areas in the sub-watershed are vulnerable to forest fires, particularly during the dry season. These fires significantly impact forest health, biodiversity, and ecosystem services.
- **Human-Wildlife conflict:** Similarly, the areas around agricultural land, the crops, vegetables and fruits have been damaged by the monkey, wild boars, porcupine and parrots are the problematic animals.
- **Marginalized communities:** Tamang and Dalits are the key caste and ethnicity in this sub-watershed. The Palika [Profile](#) (page 18) shows that there are 27 People With Disability (PwD) for whom, the project need to consider disability inclusive program while conducting watershed conservation program.

The sites in red circles are actual sites to be considered for the proper interventions to conserve the soil, water and communities in Simale sub-watershed area. The Municipal level validation workshop also endorsed these sites as the priority sites for intervention. However, the Chairperson was complaining to include ward number 2 and 3 for priority sub-watershed as these areas are the source of water at upstream area of Marin River.

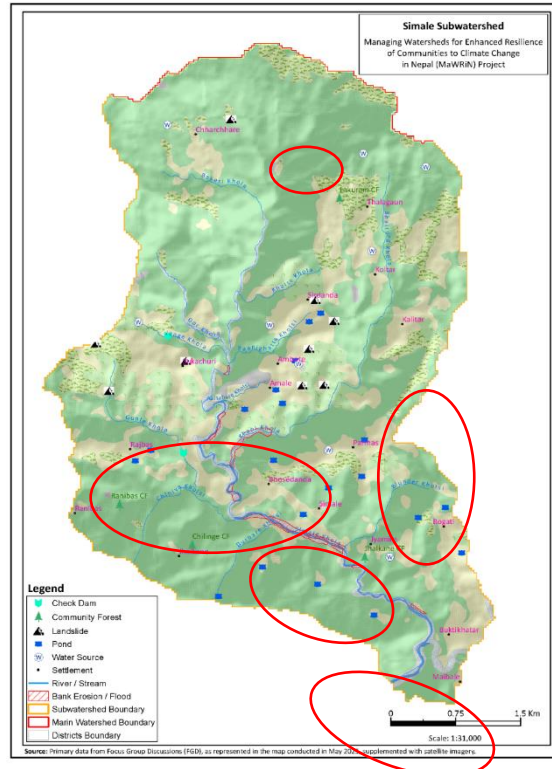


Figure 4 Assessment of vulnerability in Simale sub watershed

3.2.1.4 Integrated Adaptation Activities

During the assessment, the FGD participants and stakeholders discussed and identified, a range of integrated and community-driven adaptation interventions have been identified to address the interconnected challenges of climate change, environmental degradation, and livelihood vulnerability. These activities aim to strengthen ecosystem resilience, enhance the adaptive capacity of local communities, and promote sustainable watershed management through nature-based solutions (NbS) and participatory approaches. The list of activities with the proposed sites are illustrated in following Table 2.

Table 2 Integrated adaptation activities with XY coordinates

SN	Activities	Sites	GPS Co-ordinates	
			X	Y
1	Sustainable Forest Management			
1-1	Renew Operational Plan	All CF		
1-2	Sustainable Forest Management Training	All CF		
1-3	Maintenance of Fireline	All CF		

1-4	Cutting and weeding for forest fire control	CF		
1-5	Plantation of fruit trees like Kimbu in the CF	CF		
1-6	Plantation	Bhairung Khola shir	85.867393	27.340086
1-7	Bamboo Plantation	Devisthan		
2	Water Source Management			
2-1	Pond construction	Bachchhu tar	85.869102	27.319426
2-2	Water pond rehabilitation/maintenance (existing)	Devisthan		
3	Climate Resilient Agriculture Practices			
3-1	Irrigation Canal	Khanikhola	85.868874	27.320227
		Baseri khola - Khalte khola (Purposed)	85.858127	27.331722
		Langdi-bachhutaar Sukhachuli Irrigation (Laghuraam CFUG)		
3-2	Tunnel Farming	All areas		
3-3	Cardamom Farming	Langdi, Bachhutaar		
3-4	Improved seed support/Seed Center Establishment	At Palika Level		
3-5	Organic farming/IMP technology	Selected CFUG members		
3-6	Fruit plants support – Mango, Litchi, Citrus/Lemon, Avocado, Pine Apple, Rukh Katahar, Banana	All areas		
4	Improved Livestock Management			
4-1	Improved Shed Support	All areas		
4-2	Grass and fodder cultivation for livestock	All areas		
4-3	Support for goat keeping	All areas		
5	Nature Based Solutions			
3-1	Mesh Check Dam, Bio Check Dam	Khani khola, Amale	85.866465	27.317154
		Baseri khola, Chharchhare	85.853997	27.339659
		Panighatta khola, Sirdanda	85.863226	27.325624

		Baseri khola, Sukhachuri	85.854216	27.319487
		Gunte khola, Bhirgaun	85.840867	27.31987
		Junge khola	85.847021	27.323186
		Rajbas, Gunte Khola	85.848971	27.310601
3-2	Embankment	Khani khola, Amale	85.866037	27.316673
			85.86366	27.301995
		Simale khola	85.862106	27.301882

3.2.2 Jalkeni Sakhuri sub-watershed

Jalkeni Sakhuri sub-watershed is located within hydrological boundaries of ward no. 1 and 2 of Marin Rural Municipality and ward no. 4 and 5 of Hariharpurgadhi Rural Municipality. This sub-watershed covers a total of 11245.05 ha and extended from 167 msl to 1339 msl. This sub-watershed area also includes lot of river and streams as well as about 67.95% forested land.

3.2.2.1 Socio-economic conditions

3.2.2.1.1 Demographic characteristics

Since the population data is reported at ward level in Census report, the demographic analysis of the sub-watershed has been done at ward level. The total population in these four wards in the sub-watershed is 12,982 (male 6,320 and female 6,662) with a total household of 2,460. The average household size is 5.23, which has declined from 6.11 in 2011. The average annual population growth rate ranges from -1.14 in ward no. 5 to 0.02 in ward number 4. The ward number 4 is the only ward with positive annual population growth rate within the whole Jalkeni Sakhuri sub-watershed. The sex ratio ranges from 89.14 in ward 4 to 101.73 in ward 2. The major ethnic groups including Rai, Tamang, Magar, Dalit, Brahmin/Chhetri and Majhi. The major settlement in the area are: Bahrabishe, Simalpur, Belpur, Magauli, Hapahad, Jutpani, Chuthre, Pasa Khola, Thulo Kot, Simaras, Pokhrene, Khandanda, duighare, Jakdi Khola, Pantale, Milaln chowk, Baghkor, Danamana, Joshiban, Baseri, Malapo, dwaar Khola, AAPtar, Pange, Tika Bhairab, Aakhola, Beltar, Rekar, Tamajor, Jyamire, Hile Khola, Dote, Galchi Bhanjyang, Pange Khola, Mainatar, Sakhuri, Thulo Garduwa, Pani Ghatta, Sano Garduwa, Sano Damar, Tesre, Dharmasthali, Simal Damar, Adhyeri, Sakheri, Dobhane, Mungre, Shirdhau, Chatiban, Deurali, Bhattarai Thafal Danda, Arase Danda, Shikhar Danda, Tin ghare, Majhuwadanda, Sinjhali Danda, Sindure Dobhan, Aath Damar, Nahar Jalkepi, Damaha Danda, Bauka, Saguri Karam, and Ratamata.

Migration has become an integral part of social process and is reflected in absentee population data of the Census. Out of the total households in these four wards, 928 (37.72%) households have absentee member in the family. A total of 2,846 (21.92%) people is absent in these wards. Out of the total absentee population 58.99% are male 41.01% are female. The figures of absentee

population include both living within the country and abroad. Usually, the people migrated abroad are engaged in foreign employment. A total of 435 (17.68%) households has family member living abroad. Specifically, within-country absenteeism includes 29.93% of males and 23.89% of females, while abroad absenteeism includes 9.82% of males and 1.38% of females, making up 21.92% of the total population.

3.2.2.1.2 Agriculture and Livestock

In Jalkeni Sakhauri, agriculture remains a primary livelihood activity. The major crops cultivated across the area include rice, maize, wheat, and millet, along with mustard, potatoes, and other seasonal vegetables. During FGD, farmers reported a decline in local maize varieties due to changing climatic conditions, limited irrigation facilities, and increased incidence of pests and crop damage caused by erratic rainfall and prolonged dry spells. The use of chemical fertilizers and pesticides is widespread, primarily applied for weed control in rice fields and to combat armyworms and stem borers in maize. Although there is a gradual shift towards short-duration and drought-tolerant crops, the transition is hindered by limited access to climate-resilient seeds, modern agricultural technologies, skilled manpower, and timely weather information.

In Mungre Dobhan, fruit cultivation is also prominent, with bananas, pineapples, jackfruit, and mangoes grown and marketed locally. The area has witnessed a steady expansion of commercial vegetable farming over the past 5–6 years, particularly for crops such as potatoes, watermelon, pointed gourd, bottle gourd, and sponge gourd.

Livestock farming constitutes another vital component of the local economy. Commonly reared animals include goats, cows, buffaloes, oxen, pigs (in Magar households), and poultry. Dairy collection services have been established in Dwaar khola, Haripurghadhi-5 and Tundikhel, and there is a gradual shift from traditional to improved stall-feeding practices. In Mungre Dobhan, commercial goat farming is increasing, supported by better shed management and regular collection of manure and urine. However, artificial insemination (AI) services are still lacking in the area. Fodder is sourced primarily from local grasses, napier, mulberry, oats, and Kimbu and has been supported by Heifer for its production in some places. Open grazing is commonly practiced, and the plantation of fodder trees on private farmland is yet to be initiated.

3.2.2.1.3 Institutions

The main local institutions in the Jalkeni Sakhauri sub-watershed comprise Community Forest User Groups (CFUGs), Leasehold Forest User Groups (LFUGs), women's groups, youth clubs, women's entrepreneur committee and community development groups. These institutions play a vital role in natural resource management, social mobilization, and local development activities. CFUGs and LFUGs are primarily responsible for sustainable forest management and conservation, while women's groups and community development groups focus on empowering marginalized populations and facilitating livelihood improvements. Together, these organizations form the

backbone of community governance and participatory resource management within the sub-watershed.

3.2.2.2 Biophysical

3.2.2.2.1 Land use and land cover

The forests with area 7640.82 ha (67.95%) make up the majority of the sub-watershed's land use and land cover followed by agriculture (18.22%), sand (7.61%) and grass (4.61%).

Table 3 Land use land cover of Jalkeni Sakhauri sub-watershed

Landuse/Landcover	Area (Ha)	Percentage (%)
Barren Land	28.37	0.25
Builtup	0.56	0.00
Bush	43.81	0.39
Cliff	8.08	0.07
Cultivation	2049.29	18.22
Forest	7640.82	67.95
Grass	518.88	4.61
Pond	0.18	0.00
Sand	855.50	7.61
Waterbody	99.56	0.89
Total	11245.0	100.00

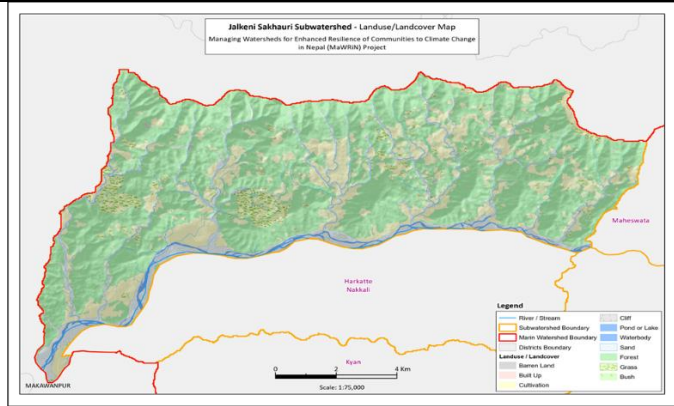


Figure 5 Land use and land cover map of Jalkeni Sakhauri sub watershed

3.2.2.2.2 Forest and Wildlife

The forests in Jalkeni Sakhauri are predominantly sub-tropical in nature, primarily managed by Community Forest User Groups (CFUGs) and Leasehold Forest User Groups (LFUGs). The dominant tree species in the area include Sal (*Shorea robusta*), Jamun (*Syzygium cumini*), Chilaune (*Schima wallichii*), Saj (*Terminalia tomentosa*), Satisal (*Dalbergia latifolia*) and Karma (*Adina cordifolia*). Additionally, plantation of lemon, bamboo, and broom grass has been carried out in several forest patches for both ecological and economic purposes. Additionally, these forests support diverse wildlife; frequently reported species include Porcupines, Monkeys, Squirrels, Parrots, Wild Boars, Leopards, and Bears.

There are is national forest along with a total of 18 CFUGs and 14 LFUGs involved in forest management in the area. Notable CFUGs include Lohasur, Chautari, Himali, Mahadev, Shikhar, Thokobaseri, Kalimati Ratmata, Janahit, Ekata Samari, Sindure Janakalyan (Wiring), Sakhauri Simaldamar, Tallo Sakhauri, Durbar danda, and Tundikhel CFUGs. LFUGs include Belpur,

Shikhar, Dabali, Pokhari, Dadapakha, Bahrabishe, Jutepani, Agathapara, Laure Kansar, Aaptar, Batase, and Tara LFUGs. These forests provide essential resources such as timber, firewood, fodder, grasses, and leaf litter, and continue to support local livelihoods. Whereas, human-wildlife conflict is a persistent problem all over the sub-watershed with occasional bear encounters in places like Sewa and Kartike, adding pressure to forest management and community well-being.

CFUG members generally pay an annual fee of Rs. 100 for access to forest products, whereas non-members are charged higher rates, such as Rs. 1250 per cubic foot of timber in areas like Tundikhel. Most CFUGs maintain operational funds ranging from NPR 5 to 25 lakhs, which are mobilized for forest management, community development, and livelihood support activities. The reliance on forests for firewood has declined in recent years due to increased adoption of LPG and electric cooking alternatives. Similarly, the number of grazing cattle has decreased, though open grazing still continues in some areas, particularly for goats. To address this, the local municipality has proposed regulatory measures to control grazing and promote forest regeneration.

3.2.2.2.3 Water Resources

The prominent streams of the sub-watershed include Dwaar khola (used extensively for irrigation), Basan khola, Bagauti khola, Dhanawana khola, Ghatte khola, Ghatte khola, Kyan khola, Lakh khola, Gargare khola, Kaami khola, Lahareni khola, Terse khola, Sirse khola, Sakhauri khola, Haaitaar khola, Thulo Garduwa, Sano Garduwa, Mungre, and Sindhure (which dries in winter). Some streams change names downstream—Gargare khola becomes Thulo Garduwa and Kaami khola turns into Sano Garduwa. Dwaar khola and Lakhkhola are especially important for irrigation in Haripurghadi-4 and 5, serving CFUGs like Shikhar, Himali, and Mahadev. Rainy-season irrigation also relies on canals such as the one on Gargare Khola fitted with a 32 mm pipe.

In addition to streams, several ponds and wells play an essential role in supporting local livelihoods. These include community and privately managed ponds like Luhaasur Kunda Pokhari (Fish Pond), Lati Khola, Tamajor, Jorsimal, and Pantale. Ground well water and traditional hand-dug wells are in use, especially in areas like Mungre Dobhan. While some ponds contain small populations of fish, local knowledge shared during FGDs indicates a decline in native fish species, such as the Katle fish, which has not been seen in recent years. The sub-watershed also faces increasing water-related hazards. Stream bank cutting, landslides, and seasonal flooding are prevalent in areas around Kaami Khola and Sirse Khola.

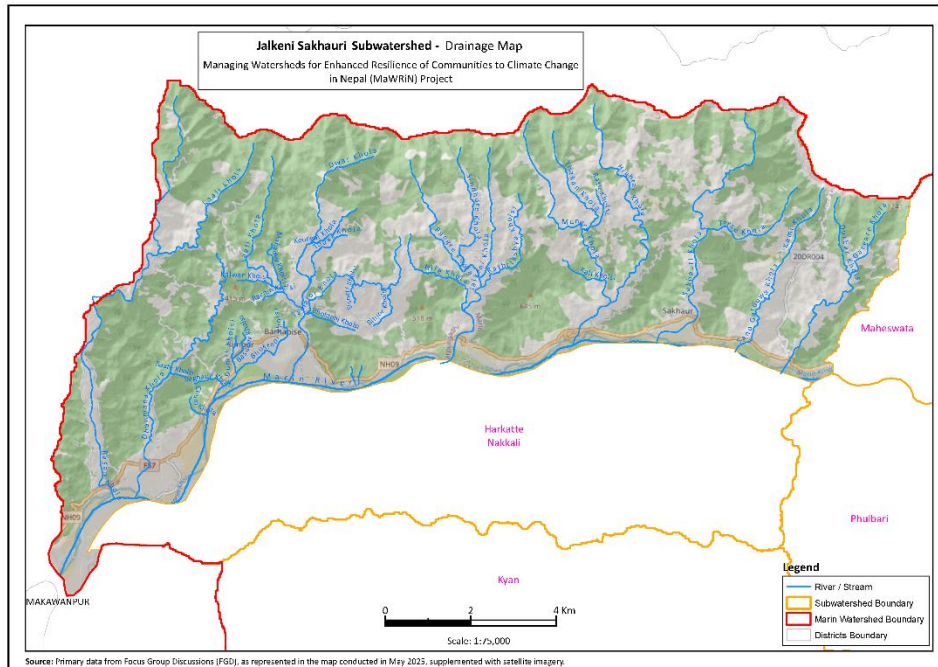


Figure 6 Streams, rivers of Jalkeni Sakhauri sub watershed

3.2.2.3 Vulnerable and Priority Sites

3.2.2.3.1 Major Hazards

The comprehensive assessments of biophysical conditions, socio-economic factors, and climate-related hazards, Jalkeni Sakhauri Khola catchment as highly vulnerable to multiple climate-induced risks such as river cutting, landslides, flooding, sedimentation, and forest fires.

Vulnerable and Priority Sites/Communities

- **Landslides:** Chum khola, area located in Dhokabaseri CF (Dwar khola), Samari CF (Mungre khola), Janakalyan CF (Hightar khola), Gargare khola, Bhalahi, Ahale are the key sites affected by the landslides.
- **Flood-prone areas and Landslide-prone areas:** Sungure, Sakhauri, Khaddamar, Simpur, Pantle, Hakpada, Bhalahi, Ahale, Jutpani, Bhutare, Simaldamar, Baghauri, Rikrike, Jalkeni, Barhabise, Tamajor are significantly affected by flood and riverbank cutting. Farmlands along the Marin River, Jalkeni khola and other streams are especially at risk during heavy rainfall and flashflood.
- **Forest fire-prone areas:** All forested and community forest areas in the sub-watershed are vulnerable to forest fires, particularly during the dry season. These fires significantly impact forest health, biodiversity, and ecosystem services.
- **Human-Wildlife Conflict:** Most of the areas within the watershed area have been complaining that they are suffered from crops, vegetables and fruits damages by monkey, and occasional bear encounters.

These hazards have been increasing in intensity over time, threatening both the ecological stability of the Chure region and the well-being of Indigenous and local communities residing in the area.

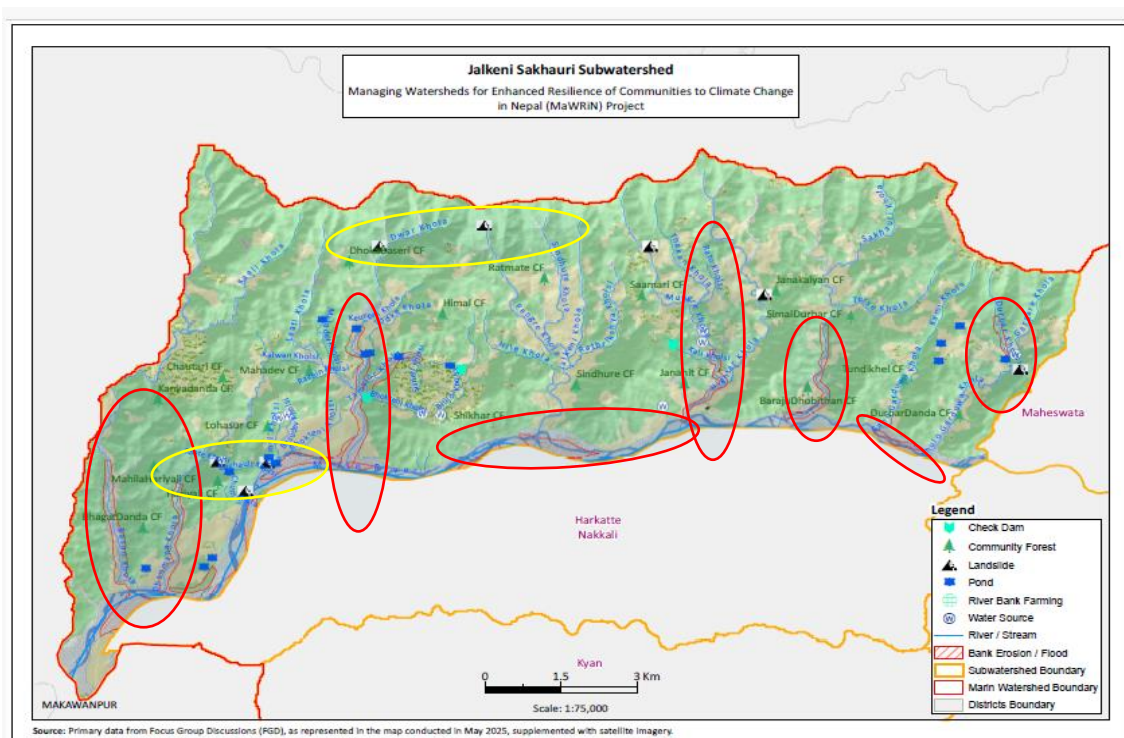


Figure 7 Assessment of vulnerability in Jalkeni Sakhauri sub watershed

3.2.2.4 Integrated Adaptation Activities

In response to these growing challenges, a set of integrated, community-led adaptation measures has been developed. These interventions are designed to tackle the combined impacts of climate change, environmental degradation, and livelihood insecurity. The focus is on enhancing ecosystem resilience, improving the adaptive capacity of local populations, and promoting sustainable watershed management through nature-based solutions and participatory approaches. A detailed list of the proposed activities and target sites is provided in Table 4.

Table 4 Integrated adaptation activities with XY coordinates

SN	Activities	Sites	GPS Co-ordinates	
			X	Y
1	Sustainable Forest Management			
1-1	Construction of Fireline	Himal CF, Upper belt of Chautari CF, West Side of Lahasur CF		

1-2	Support for equipment and awareness program for forest fire control	All CF		
1-3	Plantation	CF		
1-4	Plantation of bamboo and broom grass	Simaldamar, Sungure, Baghauri, Rikrike, Hakpada, Bhalahi, Ahale		
2	Water Source Management			
2-1	Pond construction	Sungure	85.69256	27.28852
		Tamajor	85.5718	27.28782
		Hakpada	85.53507	27.24792
		Jutpani	85.52191	27.24582
		Jalkeni	85.62497	27.29621
		Barhabise	85.56233	27.2764
		Baghkhori	85.55921	27.28319
2-2	Water Source Conservation	Khaddamar	85.63235	27.29124
		Dandapakha	85.62464	27.27867
		Thulo Garduwa	85.6885	27.27472
		Kali Khola shir	85.55241	27.315
2-3	Pond Maintenance	Baghauri	85.54611	27.26783
		Tamajor	85.58206	27.28613
		Pantale	85.56512	27.28826
3	Climate Resilient Agriculture Practices			
3-1	Irrigation Canal	Dwar khola, Uchaldhunga	85.56459	27.291707
		Dwar khola, Barhabise	85.561164	27.275621
		Bhokteni khola, Simpur	85.55443	27.27394
		Hightar khola, Tilbari	85.643299	27.290802
		Sirse-Tundikhel Irrigation Canal	85.688215	27.290949
		Hile Khola, Simaltar	85.602364	27.284588
		Dhanmana khola, Ratmata	85.543574	27.283472
3-2	Tunnel Farming	All areas		
3-3	Improved seed support/Seed Center Establishment	At Palika Level		

3-4	Support in Agricultural tools and farming training	All areas		
3-5	Marsh Farming	All areas		
3-6	Promote local seeds of Maize, Rice and Millet	All areas		
3-7	Fish farming	Dwaar khola		
3-8	Promote commercial farming (mushroom, vegetable, fruits)	All areas		
4	Improved Livestock Management			
4-1	Improved Shed Support	All areas		
4-2	Grass and fodder cultivation for livestock	All areas		
4-3	Support for goat keeping	All areas		
4-4	Improved Breed Livestock	All areas		
4-5	Production of FYM	All areas		
5	Nature Based Solutions			
5.1	Check Dam	Jalkeni	85.62653	27.29069
		Barhabise	85.56553	27.27989
		Tamajor	85.58425	27.28534
5.2	Embankment	Sungure	85.692964	27.28959
		Sakhauri khola, Sakhauri	85.656875	27.280806
		Mungre khola, Khaddamar	85.632292	27.280138
		Marin-Dwar khola junction, Simpur	85.559276	27.267765
		Dwar khola, Paantale	85.562914	27.283854
		Marin khola, Hakpada	85.537342	27.250215
		Dwar khola, Bhalahi	85.568508	27.308783
		Pangre khola, Ahale	85.588703	27.312612
		Dhanmana khola, Jutpani	85.525384	27.245244
		Marin-Basan khola junction, Bhutare	85.51856	27.241627
Sakhauri-Terse khola junction, Simaldamar	85.65891	27.29909		

	Marin River, Baghauri	85.546333	27.266703
	Mungre khola, Rikrike	85.618162	27.311597
	Mungre khola, Jalkeni	85.624861	27.298109
	Dwar khola, Barhabise	85.563193	27.276523
	Tamajor khola, Tamajor	85.573602	27.287796

3.2.3 Dhungajor sub-watershed

The sub-watershed falls in three wards: 1, 4 and 5 of Kamalamai Municipality. Of these three wards, only a small part with a few households of ward number 5 is within the sub-watershed. Likewise, ward no 1 is also shared by Ghagar Sub-watershed. The sub-watershed covers an area of 4,547.15 ha.

3.2.3.1 Socio-economic features

3.2.3.1.1 Demographic Characteristics

Since the population data is reported at ward level in Census report, the demographic analysis of the sub-watershed has been done at ward level. The total population in these three wards in the sub-watershed is 21,675 (male 10,437 and female 11,238) with a total households of 5,552. The average household size is 3.90, which has declined from 4.54 in 2011. The average annual population growth rate ranges from -0.51 in ward no 1 to 3.57 in ward number 4. The ward number 4 and 5 are the wards with highest annual population growth rate within the whole Marin Watershed. The sex ratio ranges from 90.14 in ward 5 to 95.56 in ward 4. The major ethnic groups are Tamang, Magar, Brahman, Chhetri, Dalit, Newar, Majhi, and Hayu. The major settlements in the sub-watershed are: Dandi Chaurai, Swara Balad, Kafletaar, Kharkhola, Khair Khola, Alauta, Swaran, Saatdhara, Chauraaie, Daandi, Guraanse, and Manedihi.

Migration has become an integral part of social process and is reflected in absentee population data of the Census. Out of the total households in these three wards, 1,905 (34.31%) households have absentee member in the family. A total of 3,579 (16.31%) people are absent in these wards. Out of the total absentee population 2,342 (65.44%) are male and 1,237 (34.66%) are female. The figures of absentee population include both living within the country and abroad. Usually, the people migrated abroad are engaged in foreign employment. A total of 811 (15.22%) households has family member living abroad. Specifically, within-country absenteeism includes 16.22% of males and 10.82% of females, while abroad absenteeism includes 8.80% of males and 1.45% of females, making up 5.01% of the total population.

3.2.3.1.2 Agriculture and livestock

Agriculture is the main source of livelihood in the sub-watershed. Largely, agriculture is characterized by mix farming systems comprising crop production and animal husbandry. It is of subsistence type. The major crops grown are paddy and maize. Over the years, farmers have been growing winter maize in place of spring maize in the areas where irrigation facility is available. Other crops include millet, pulses (such as lentils and beans), oilseeds (including mustard), and vegetables (such as tomatoes, potatoes, and cabbage). The common horticultural crops include mango, litchi, pineapple, guava, banana and citrus fruits at smaller scale.

Majority of the participants of Badripur, Dravyatar, Kundule, and Kafletar perceived that long dry spell, unpredictable and erratic rainfall and hailstorm reduced the agricultural productivity affecting more on staple crops like millet, maize. Most of the farming in these areas remains rain-fed, with only limited irrigation support from canals that often run dry in winter and the dry season. The farmers of the area including Kafletar have begun transitioning to short-duration and drought-tolerant crops, mainly paddy and mustard and vegetables, though progress is limited by inadequate access to irrigation and timely weather information.

Livestock is another major component of livelihood. The common livestock are Goat, Cattle, Buffalo, Pig and poultry. Generally, goats are grazed in the community forests. Other animals are stall fed. People usually collect fodder from nearby forest and planting of fodder trees in their farm is yet to be initiated. In the recent past, people have started growing grasses like Rye, Napier, and Berseem. Over the years, the number of animals kept has decreased.

Milk production in the area closer to roadhead is an important economic activity. In addition to agriculture, one of the major livelihood means is remittance.

3.2.3.1.1.3 Institutions

In Dhungajor, a diverse range of local institutions actively contribute to community development, resource management, and livelihood support. These include Community Forest User Groups (CFUGs), cooperatives, micro-finance groups, and various women-led organizations. Notable among them are the Koili Devi Uddhamshil Krishi Mahila Samooh (a women-based farmer group) and the Paribartan Women Group, both of which focus on empowering women through agricultural and income-generating activities. Additionally, farmer groups and temple protection committees are engaged in promoting sustainable agriculture and safeguarding cultural and religious sites.

3.2.3.2 Biophysical

3.2.3.2.1 Land use and land cover

The land use land cover classes in the sub-watershed is in the table. Out of the total area forests accounts for 73.81% of the total areas followed by agriculture (13.89%), sand (9.79%), and waterbodies (1.04).

Table 5 Land use land cover of Dhungajor sub-watershed

Land Use / Land Cover	Area (Ha)	Percentage (%)
Barren Land	35.25	0.78
Bush	12.14	0.27
Cliff	0.61	0.01
Agriculture	631.69	13.89
Forest	3356.58	73.81
Grass	18.89	0.42
Sand	445.35	9.79
Waterbody	47.23	1.04
Total	4547.75	100.00

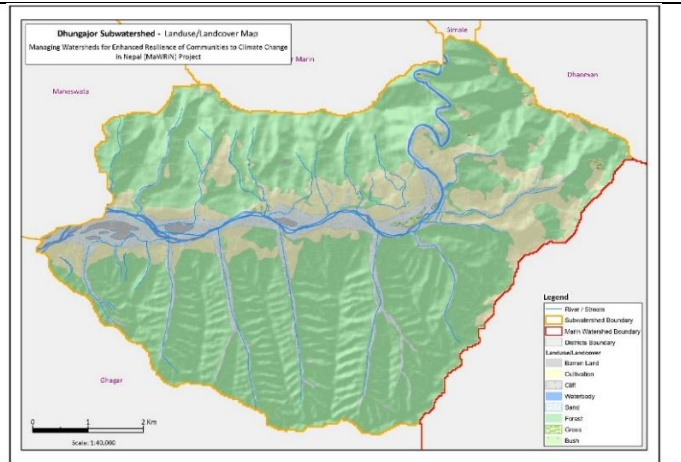


Figure 8 Land use and land cover map of Dhungajor sub-watershed

3.2.3.2.2 Forest and wildlife

The type of forest in the area is sub-tropical and tropical with common tree species of Sal (*Shorea robusta*), Khayar (*Acacia catechu*), Sissoo (*Dalbergia sissoo*), Asana (*Terminalia tomentosa*), Karma (*Adina cordifolia*), Champ (*Michelia champaca*), Simal (*Bombax cieba*), Jamun (*Syzygium cumini*), Botdhangero (*Lagerstromia parviflora*), Ghangaru (*Pyracantha crenulata*) and bamboo (*Dendrocalamus spp.*). Local communities have reported a noticeable decline in native tree species like Sal (*Shorea robusta*) and Katus (*Castanopsis indica*). There are national forest, community forest, and private forest under the jurisdiction of DFO. There is a total of 12 CFUGs within the sub-watershed. These forests provide essential resources such as timber, fodder, grasses, and leaf litter. The CFUGs have been renewed and their operational plans are functioning. However, reliance on forest mainly for fuelwood and grazing has decreased in recent years due to increased use of LPG and reduction in cattle numbers.

The common wildlife found in these forests are wild boar, Jackal, Monkey, Porcupines, Squirrel, Parrots, and occasionally Leopard. Among these, wild boar, monkeys, porcupine, and parrots cause significant damage to crop like maize, rice, millets, fruits, and vegetables. Over the years, crop damage by wildlife especially monkey, wild boar, porcupine, and parrots has become one of the major problems for crop production.

3.2.3.2.3 Water Resources

The major rivers and springs are Jalewa Khahare, Jakhane Khahare, Bhootaha Khola, Daadi Khola, Saatdhara, Bhusune Khola, Lipe khola, Maiti khola, and Bhalu Kholsi. However, these sources have been significantly impacted by river cutting, landslides, and the deposition of sediment loads, especially the Khahare Khola. In the upper part of the sub-watershed local springs are maintained and intake has been constructed to supply drinking water for the local community. Similarly, well and hand pump are also used to drink water and irrigation. In Badripur, wells remain the primary source of water. In the upstream some households use plastic ponds for irrigation purposes. Similarly, rainwater harvesting has also been initiated for irrigation. It was widely reported that over the years, the water availability has declined. It was reported that the earthquake of 2015 also led to shifting or drying of water springs/sources. Owing to decline in water quantity and quality and destructive fishing in the recent past, fish population and species of fish have greatly declined in Marin Khola.

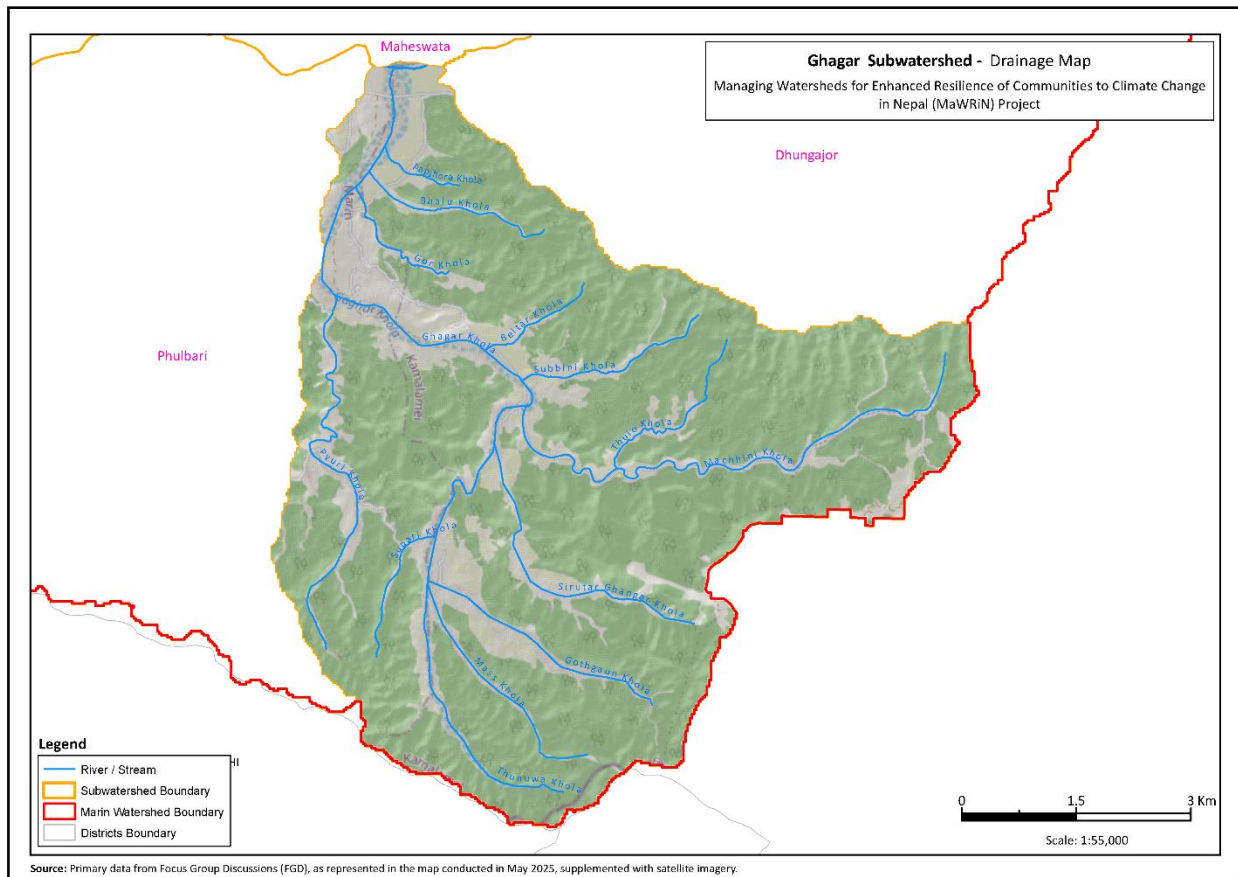


Figure 9 Streams, rivers of Dhungajor sub watershed

3.2.3.3 Vulnerable and Priority Sites

3.2.3.3.1 Major Hazards

Based on a participatory assessment (including field observations and focused group discussions), along with GIS mapping, the primary hazards identified in the Dhungajor sub-watershed include landslides, riverbank cutting, floods, and forest fires. Similarly, human-wildlife conflict is another important problem in this sub-watershed.

Vulnerable and Priority Sites

- **Landslide-prone areas:** Hattibanda Khahare Kholsi, Dandi Khahare Khola (Chanaute), Maitai Khola (Kundule), Lipi Khola (Kundule), and Satighat are significantly affected by landslides. These events have severely damaged ecosystems, agricultural lands, and infrastructure.
- **Flood-prone areas:** Jalewa Khahare (Drabyataar), Hattibanda Khahare, Dhungajor Khahare, Jakheni Khahare (Bande), Marin Khola (at Swarna), and Bhalu Kholsi experience frequent flooding events that disrupt livelihoods and degrade natural systems.
- **Riverbank cutting areas:** The confluence of Marin and Bhutaha Khola at Kafletar, as well as Bhutaha Khola itself, are major hotspots for riverbank erosion. Farmlands along the Marin River are especially at risk during heavy rainfall in upstream regions.
- **Forest fire-prone areas:** All forested and community forest areas in the sub-watershed are vulnerable to forest fires, particularly during the dry season. These fires significantly impact forest health, biodiversity, and ecosystem services.
- **Drought-affected areas:** Villages such as Chanaute, Darbetar, Bande, and Kundule, suffer from reduced agricultural productivity due to prolonged dry spells and lack of water. Construction of recharge ponds in these areas would be crucial for maintaining soil moisture and ensuring sustainable agricultural and livestock yields.
- **Marginalized communities:** Areas like Astani, Simale, Kopche, Manedihi, and Guranse are inhabited by marginalized ethnic groups like, Majhi and Hayu. These communities are particularly vulnerable to the combined impacts of climate-induced hazards and socio-economic marginalization.

These hazards have intensified over time, posing serious threats to the ecological integrity of the Chure landscape and the livelihoods of Indigenous and local communities living in the area.

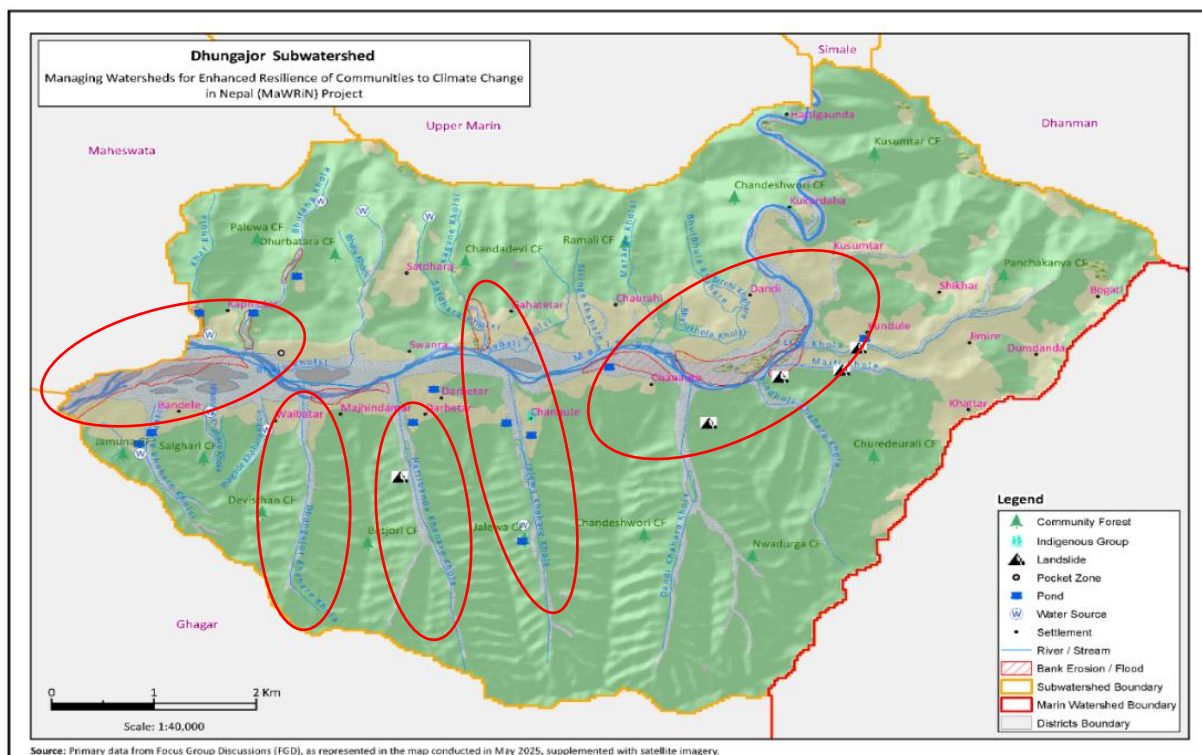


Figure 10 Assessment of vulnerability in Dhungajor sub watershed

3.2.3.4 Integrated Adaptation Activities

In order to address the risks and challenges identified about and build resilience, a range of integrated and community-driven adaptation interventions have been identified to address the interconnected challenges of climate change, environmental degradation, and livelihood vulnerability and capture the opportunities.

Table 6 Integrated adaptation activities with XY coordinates

SN	Activities	Sites	GPS Co-ordinates	
			X	Y
1	Sustainable Forest Management			
1-1	Forest Management Training	All CFUGs		
1-2	Maintenance of Fireline	All CFUGs		
1-3	Cutting and weeding for forest fire control	All CFUGs		
1-4	Plantation of fruit trees in the CF to	All CFUGs		

	retain the Monkey and birds in the forest area (Kimbu is one of the best fruits)			
1-5	Plantation	Bandeale	85.81623	27.24776
1-6	Control Grazing	All CFUGs		
2	Water Source Management			
2-1	Pond construction	Chanoute	85.847811	27.246855
		Drabyatar	85.845330	27.248057
		Sat Dhara		
		Thumka		
		Jalewa Khare Khola	85.847027	27.236274
		Jakheni Khahare Kholsi	85.810315	27.246796
		Purano Dihi		
		Panchakanya CFUG	85.897303	27.262979
		Bhutaha Khola		
		Hattibanda Khahare Khola	85.836113	27.248046
	Lipe Khola	85.880621	27.256757	
3	Climate Resilient Agriculture Practices			
3-1	Irrigation Canal	Salbote – Bandelefanta – Ahale – Kalthan (approx. 2 km), from Bhutaha Khola to Simle Tar	85.81805031	27.25142176
		Simle Irrigation Canal, Maitikhola - Panchakanya CFUG	85.87498253	27.25475495
3-2	Tunnel Farming	All CFUG (Bhalu Kholsi Junction, Salghari CFUG, Bandeale, Bhalu Kholsi Dada)		
3-3	Improved seed support/Seed Center Establishment	At Palika Level		
3-4	Organic farming/IMP technology	All areas		

3-5	Training for the production of Organic Fertilizer`	All CFUG		
3-6	Support in Establishment of Organic Manure Preparation Center	Badripur		
3-7	Support in establishment of Vegetable Collection Center	Kamalamai-1, ward office		
3-8	Women friendly, time saving and energy saving tools and technologies	Panchakanya CFUG		
4	Improved Livestock Management			
4-1	Improved Shed Support	All areas		
4-2	Grass and fodder cultivation for livestock	All areas		
4-3	Support for goat keeping	All areas		
4-4	Support for pig farming	All CFUG		
4-5	Mobile veterinary services and vaccination drives	All areas		
4-6	Animal Health Worker Training	All areas		
5	Nature Based Solutions			
5-1	Check Dam/Gully Control/Landslide Mitigation	Hattiban Khare Khola,	85.83488	27.24257
		Dandi Khare Khola, Chanoute	85.86528	27.24822
		Maiti Khola, Kundule,	85.87839	27.25362
		Lipe Khola, Kundule,	85.88001	27.25583
		Sathighat, Kundule	85.87232	27.25286
5-2		Marin-Jalewa Khare River Junction, Chanoute	85.84760	27.24946
			85.84519	27.24887

	Bio-engineering Practices with Embankment	Marin-Hattibanda Khare Junction, Majhinidamar	85.83584	27.24831
			85.83340	27.25009
		Marin-Dhungejor Khare Junction, Waibatar	85.82604	27.24801
			85.82440	27.24917
		Marin-Jalkhene Khahare junction, Jhakeni	85.80997	27.24796
		Marin-Sabali Khahare Junction, Gahatatar	85.84766	27.25374
		Marin Khola, Swanra	85.84090	27.25388
		Marin-Bhalu Kholsi Junction		
		Marin-Bhutaha Khola Junction, Kafletar,	85.87628466	27.2599985
			85.87608556	27.26035296
		Marin-Kharkhola Junction, Kharkholagaun	85.81443575	27.2588608
			85.81430156	27.25890725
		Kagune Khola, Swanra	85.84256	27.25788
		Marin River, Kudule	85.87498226	27.25636636
		Dhanyar Khahare	85.81706212	27.24755448
		Ratmate Khahare Khola	85.80717384	27.24663557
		Bhusune Khahare Khola	85.81535595	27.24841203
		Chimte Khahare	85.81414001	27.24006663
		Jakhene Khahare Kholsi, Jakhane, Bandele	85.80998056	27.24663304
			85.8096488	27.24683725
Lipi Khola, Kundule	85.87648338	27.25579496		
	85.87560244	27.25589395		
5-3	Plantation of Bamboo and Broom Grass	Jakhane Khare (2 CFUG), Damar Khare, Dhanyar Khare, Ratamate, Bhusuna Khare, Chamte, Kafletar, Marin-Sabeli Junction, Gahetatar, Panchakanya CFUG, Lipikhola Embankment, Lower Part of Marin River, Bhusune Khola		
6	Preservation of Social and Cultural practices of highly Marginalized Groups			
6-1	Designing special activities to promote their cultural and socio-economic activities of marginalized	Adhamara	85.81381	27.27695
		Astani, Simale, Kopche,	85.80386	27.27204
		Manedihi	85.82717	27.27860
		Guranse	85.84033	27.27276

groups (Hayu, Majhi, Dalits)			
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3.2.4 Ghagar Sub-watershed

The Ghagar sub-watershed, situated at elevations ranging from 320 to 840 meters above sea level, covers an area of 4,998.31 hectares. It stretches across two administrative divisions: ward no. 1 of Kamalamai Municipality and ward no. 5 of Marin Rural Municipality. However, these wards are not exclusively part of the Ghagar sub-watershed, ward no. 1 also lies within the Dhungajor sub-watershed, while ward no. 5 overlaps with the Phulbari sub-watershed.

3.2.4.1 Socio-economic conditions

3.2.4.1.1 Demographic characteristics

As the Census report presents population data at the ward level, the demographic analysis of the sub-watershed has also been carried out accordingly. The total population in the two wards of the sub-watershed is 7,425 (male 3,614 and female 3,811) with a total of 1,755 households. The average household size is 4.23, which has declined from 5.11 in 2011. The average annual population growth rate is -0.51 in Ward No. 1 and -0.02 in Ward No. 5. The sex ratio has increased from 88.99 to 92.78 in Ward No. 1 and from 88.49 to 98.2 in Ward No. 5. The major ethnic groups are Tamang, Majhi, Brahmin, Chhetri (notably the Thapa subgroup), Cheewa, and Dalit. The major settlements in the Ghagar sub-watershed are: Beltar, Damar, Ghumaune, Subbini, Bhiman, Mahabeni, Chauki danda, Biyuri, Badi Muhan, Kunda, Nepane, Bod Khola, Thunuwa, Simtar, Jogi Damar, Khayar Sal, Tikshanal, and Dud Khola Nepane.

Migration has become a significant aspect of the social structure, as evidenced by the absentee population figures reported in the Census. Out of the total households in these two wards, 523 (29.80%) households have absentee members in the family. A total of 1,231 (16.58%) people are absent in these wards. Out of the total absentee population, 779 (63.29%) are male and 452 (36.71%) are female. The figures of absentee population include both those living within the country and abroad. Usually, the people migrated abroad are engaged in foreign employment. A total of 251 (14.30%) households have family members living abroad. Specifically, within-country absenteeism includes 13.97% of males and 10.94% of females, while abroad absenteeism includes 7.47% of males and 0.91% of females, making up 4.11% of the total population.

3.2.4.1.2 Agriculture and Livestock

The Ghagar Sub-Watershed relies heavily on agriculture and livestock for livelihoods. While traditional farming practices still dominate, gradual shifts toward modernization are evident, such as the use of hybrid crops, motor pumps, and tractors. Key crops include rice, maize, millet, mustard, and potatoes. Vegetables like potatoes, cauliflower, cabbage, onions, and tomatoes (some grown in tunnels) are produced for both subsistence and limited trade. However, high transport costs and post-harvest losses reduce profitability, particularly for fruits like pineapple, bananas and mangoes. Fertilizers such as urea and DAP are commonly used alongside compost; pesticides are applied mainly to maize and rice and herbicides are also applied in rice, though agro-vet service access remains uneven.



Photo 12: Pineapple farming in Ghagar sub-watershed

Livestock rearing remains integral, with goats, cows, buffaloes, pigs, and poultry widely kept. Although tractors have replaced oxen for ploughing in many areas, livestock are still crucial for manure, especially where fertilizer is scarce. Some areas have taken steps to limit open grazing and protect saplings, but goat grazing remains widespread. A few households have ventured into small-scale commercial farming, yet the majority still follow traditional practices. In Nepane, some household rear larger herds and seed goats, but veterinary support is limited, with no artificial insemination services and minimal disease prevention from ward office.

Irrigation remains a key challenge, especially during the dry season. Though canals, ponds, and motor pumps provide some relief, water scarcity persists most acutely in Beltar, where drying canals have led to crop failures and bamboo encroachment, which locals link to disappearing water sources. Rainfed agriculture predominates in Nepane and Chauki danda, leaving crops vulnerable to erratic rainfall and seasonal storms, particularly in Baishakh (April/May).

Overall, the Ghagar Sub-Watershed reflects a strong but fragile agricultural system in slow transition, constrained by limited infrastructure, market access, and mounting environmental and climatic stresses.

3.2.4.1.3 Institutions

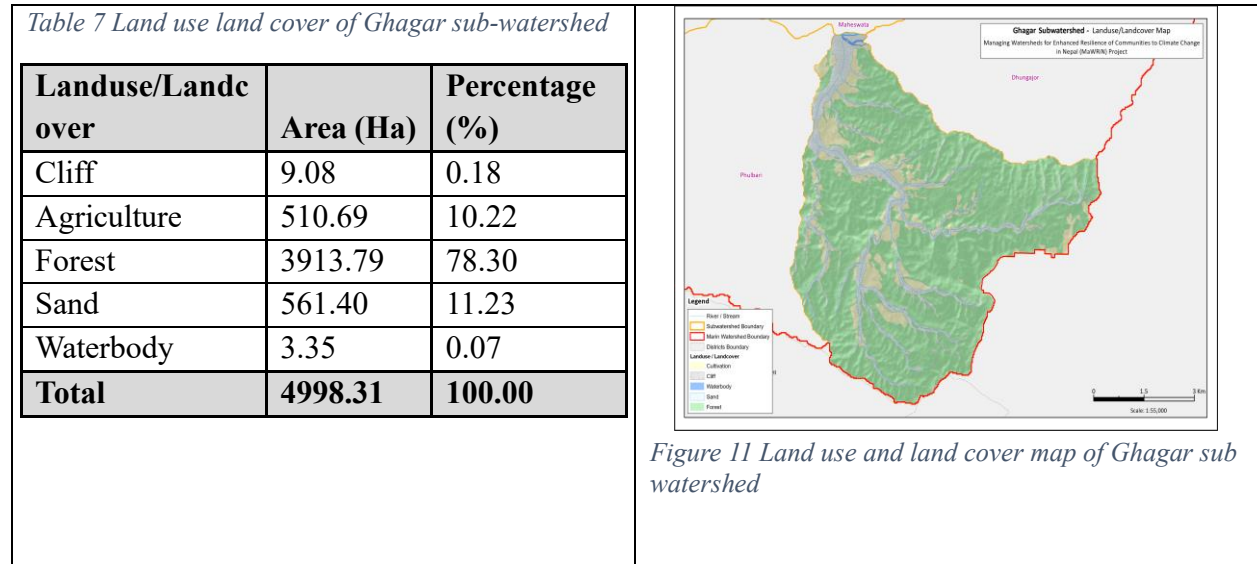
The main local institutions in the Ghagar sub-watershed include Community Forest User Groups (CFUGs), saving and credit cooperatives, youth clubs, and women's groups. These organizations play a crucial role in supporting natural resource management, promoting social cohesion, and advancing local development initiatives. In Nepane, institutions such as the Saptarangi Youth Club and the Sayapatri Women's Group are actively involved in community engagement and

mobilization. In Beltar, institutional presence is more robust, with the Hariyali Saving Cooperative, a local CFUG, and the Drinking Water User Group contributing to sustainable forest use, financial inclusion, water management and access to basic services.

3.2.4.2 Biophysical

3.2.4.2.1 Land use and land cover

Out of the total area, the forests (78.30%) make up the majority of the sub-watershed's land use and land cover followed by sand (11.23%), agriculture (10.22%) and cliff (0.18%).



3.2.4.2.2 Forest and Wildlife

The type of forest in the area is sub-tropical and tropical with common tree species of Sal (*Shorea robusta*), Khayar (*Senegelia catechu*), Sissoo (*Dalbergia sissoo*), Asna (*Terminalia tomentosa*), Karma (*Adina cardifolia*), Champ (*Michelia champaca*), Simal (*Bombax cieba*), Jamun (*Syzygium cumini*), Chilaune (*Schima wallichii*), and bamboo (*Dendrocalamus spp*s). NTFPs like Tama (bamboo shoots), Kurilo (*Asparagus racemosus*), Harro (*Terminalia chebula*), Barro (*Terminalia bellirica*), Amala (*Phyllanthus emblica*), Niuro (*Diplazium esculentum*), Babiyo, and broom grass are collected primarily for household use, with limited local trade. In addition to their ecological significance, these forests support diverse wildlife; frequently reported species include Leopard, Deer, Wild Boar, Porcupine, Fox, and Peacock.

There are national forests, community forests, leasehold forests and private forests under the jurisdiction of DFO. There is a total of 20 CFUGs within the sub-watershed. These forests provide essential goods and services such as timber, fodder, grasses, and leaf litter and they remain central to sustainable forest management and local livelihoods.

Variations in forest management and pressure are evident across the three settlements. In Beltar, forest conditions have improved due to proactive measures adopted by CFUGs, including riverbank stabilization, fire control through fireline establishment, and regulated grazing. Plantation activities involving bamboo, broom grass, and lemon trees are being implemented to support forest regeneration. Chauki danda, in contrast, experiences relatively greater pressure on forest resources, attributed to lower LPG adoption rates and continued open grazing practices. Nepane demonstrates a positive example of forest conservation, having achieved full household coverage with LPG through CFUG support, thereby significantly reducing pressure on forest biomass. Commonly harvested non-timber forest products (NTFPs) across the sub-watershed include *Phyllanthus emblica* (Amala), *Asparagus racemosus* (Kurilo), and *Diplazium esculentum* (Niuro), primarily for household use and limited local trade.

3.2.4.2.3 Water Resources

The Ghagar sub-watershed encompasses diverse water sources, including rivers, streams, ponds, and community-managed supply systems. These sources play a crucial role in fulfilling local needs for drinking water, irrigation, livestock use, and ecological balance. However, water availability in the area is highly seasonal, with many streams drying up during winter/dry period and surging in the monsoon, reflecting the impacts of climate variability and increasing water stress in certain pockets of the sub-watershed.

In Beltar, water supply services are supported through systems like in Jaldevi, where water is pumped from the river, and through the Sirjanshil CFUG, which has constructed intake structures to supply water. In Subbini, a water intake system was established with support from the President Chure-Terai Madhesh Conservation Development Board (PCTMCDB), which also constructed a subsurface cutoff structure to enhance water retention and reduce seepage into the ground. In Chauki danda, two perennial streams serve CFUGs such as Raino, Namobuddha, and Jhor, though upstream sections tend to dry out in winter. Drinking water is primarily supplied through the LIFT project by NEWA, supplemented by traditional and ground wells. In Nepane, Ghagar khola remains a key perennial source, though the drying of streams is becoming more frequent. There are also 4–5 ponds, and Mahamandal shir serves as the main drinking water source. In areas like God khola and Thunuwa, water is supplied via tankers, especially during dry periods. Interestingly, the presence of fish in rivers during the monsoon reflects the seasonal biodiversity linked to these aquatic systems.

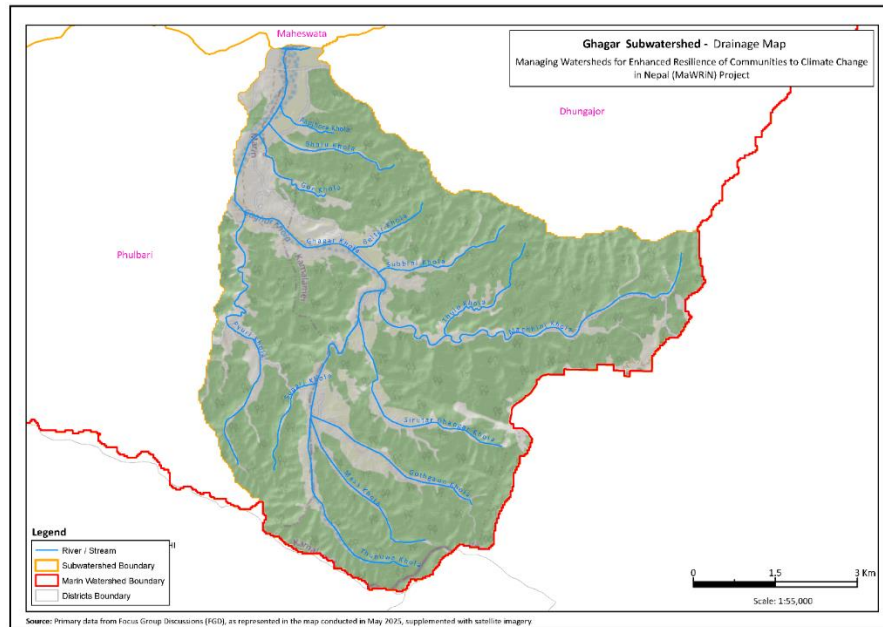


Figure 12 Streams, rivers of Ghagar sub watershed

3.2.4.3 Vulnerable and Priority Sites

3.2.4.3.1 Major Hazards

Based on a participatory assessment including field observations and focused group discussions, along with GIS mapping, the primary hazards identified in the Ghagar sub-watershed include flooding, sedimentation, forest fires, and prolonged droughts.

Vulnerable and Priority Sites/Communities

- **Flood-affected areas and river cutting:** During intense rainfall, confluence of Marhi River and Ghagar khola at Sirutar, Thunuwa khola at Nepane and Bhiman, Goth gaun khola, confluence of Ghagar khola and Beltar khola, confluence of Ghagar and Subbini khola, confluence of Goth gaun khola, Thunuwa khola and Mass khola, Pyuri dobhan, Pyuri shir, Chauki danda, Kunda, Sunkhani, School bhitta at Beltaar area experience flash floods and riverbank cutting that wash away crops, damage foot trails, and disrupt community mobility, while floodwaters erode fertile riverbanks, threatening farmlands, public lands, infrastructures and settlements. The FGD participants shared that due to flood in Ghagar khola, houses, schools and suspension bridges are in danger.
- **Forest fire hotspots:** Community forests located in the sub-watersheds are increasingly experiencing forest fires during dry months (March–May). It has threatened biodiversity and contributing to the loss of forest cover and ecosystem services.
- **Water scarcity:** Settlements such as Nepane, Beltaar, Chauki danda, Raino, Namobuddha, Jhor face water deficiency during the dry season. Whereas the rivers/streams increase in

the rainy season and dries up in the winter face prolonged dry spells during winter and spring, leading to water shortages for drinking, irrigation, and livestock. Water sources are drying up especially in upstream areas during the winter, and reduced soil moisture is impacting on low crop yields.

- **Landslide-prone zones:** Settlements and farmlands near steep slopes and unstable soils, are highly susceptible to landslides especially in Dudh khola. Landslides during the monsoon have led to recurrent losses of land and infrastructure.
- **Human-Wildlife Conflict:** Most of the areas within the watershed area have been complaining that they are suffered from crops, vegetables and fruits damages by Monkey, Porcupine and Parrot.
- **Marginalized and vulnerable populations:** Ethnic groups such as Majhi and Dalits in Kunda, and other areas face higher climate risks due to poor access to basic services and limited adaptation capacity.

These hazards have intensified in recent years, threatening the ecological integrity of the Chure landscape and the livelihoods of indigenous and local communities residing in the area.

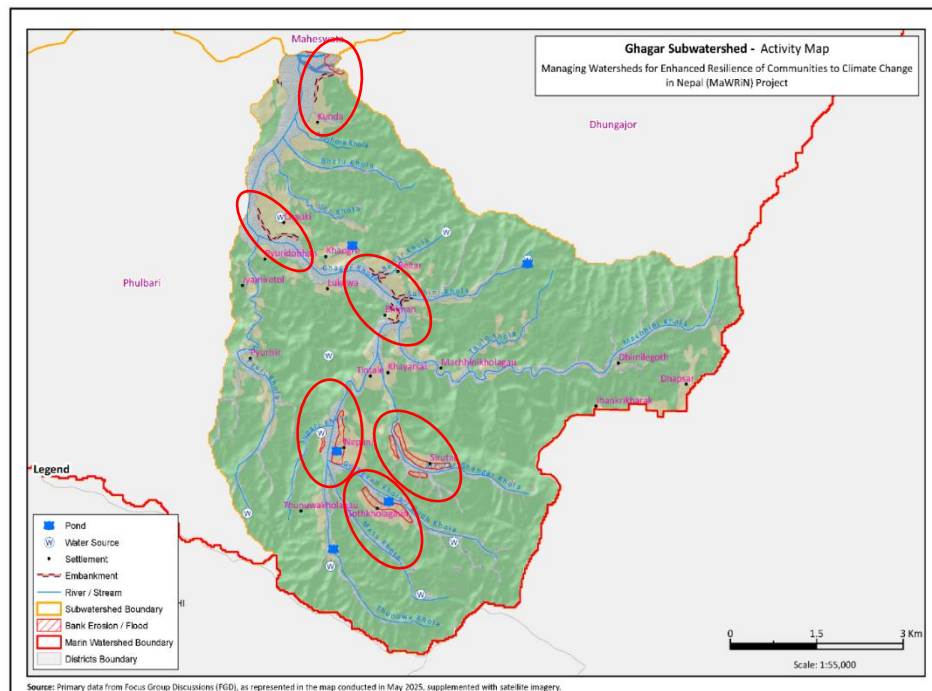


Figure 13 Assessment of vulnerability in Ghagar sub watershed

3.2.4.4 Integrated Adaptation Activities

During the assessment, the FGD participants and stakeholders discussed and identified, a range of integrated and community-driven adaptation interventions have been identified to address the

interconnected challenges of climate change, environmental degradation, and livelihood vulnerability. These activities aim to strengthen ecosystem resilience, enhance the adaptive capacity of local communities, and promote sustainable watershed management through nature-based solutions (NbS) and participatory approaches. The list of activities with the proposed sites are illustrated in following Table 8.

Table 8 Integrated adaptation activities with XY coordinates

SN	Activities	Sites	GPS Co-ordinates	
			X	Y
1	Sustainable Forest Management			
1-1	Forest Management Training	All CFUGs		
1-2	Equipment for forest fire control	All CFUGs		
1-3	Plantation of fruit trees in the CF to retain the Monkey and birds in the forest area (Kimbu is one of the best fruit)	All CFUGs		
1-4	Production of Compost fertilizer (collection of leaf litter)	All CFUGs		
1-5	Control Grazing	Triveni, Ghaghar, Ghiukhur (Naulo Srijana) Community Forest		
2	Water Source Management			
2-1	Pond construction	Khagre	85.80451	27.22215
		Nepane	85.80212	27.19140
		Gothgaun khola, Gothkhola gaun	85.81129	27.18393
		Thunuwa khola	85.80164	27.17675
		Subbini khola shir	85.83525	27.21970
2-2	Water Source Conservation	Mass khola Sir	85.81702	27.17008
		Gothgaun khola Sir	85.82274	27.17799
		Thunuwa khola	85.80119	27.17417
		Thinuwa-Supari khola junction	85.79933	27.19411
		Pyuri khola shir	85.78656	27.18202

		Raino Community Forest	85.80052	27.20565
		Beltar Khola shir	85.82091	27.22433
		Subbini khola shir	85.83519	27.22024
		Chauki danda	85.79183	27.22629
2-3	Drinking Water	3.5 km Mas Khola Maha Mandal (NEWA project)		
3	Climate-Resilient Agriculture Practices			
3-1	Drip Irrigation	Beltar		
3-2	Apiculture	Nepane		
3-3	Tunnel Farming	All areas		
3-4	Support for Agricultural Tools	At Palika Level		
3-5	Improved seed support/Seed Center Establishment	At Palika Level		
3-6	Organic farming/IPM technology	All areas		
4	Improved Livestock Management			
4-1	Improved Shed Support	All areas		
4-2	Grass and fodder cultivation for livestock	All areas		
4-3	Support for goat farming	All areas		
4-4	Support for Pig farming	Nepane		
4-5	Improved Breed Livestock	All areas		
4-6	Training related to Vet Services	Chauki danda		
5	Nature based Solutions			
5-1	River Bank/ Flood Protection/Gully Control	Ghagar-Beltar Junction	85.807586	27.217770
		Thunuwa khola, Bhiman	85.811799	27.210795
			85.813958	27.209931
			85.811118	27.209963
		Thunuwa khola, Nepane	85.802578	27.192725
		Thunuwa khola, Thunuwa KholaGaun	85.799888	27.183245
		Thunuwa khola -Supari khola Junction	85.799578	27.192172
		Goth Khola Gaun	85.808787	27.183736
		85.817175	27.189580	

		Sirutar Ghagar khola, Sirutar	85.812043	27.192294
			85.816473	27.187989
5-2	River bank protection and bio-engineering practices and embankment structures	Marin khola - Ghagar khola Junction	85.790676	27.248652
			85.797995	27.245931
		Ghagar khola, Chauki danda	85.791659	27.223548
		Ghagar - Beltar khola Junction	85.810043	27.217570
		Ghagar - Beltar khola Junction	85.808757	27.218038
		Thunuwa khola, Bhiman	85.812101	27.212685
		Ghagar - Subbini khola Junction	85.812825	27.214478
		Ghagar - Subbini khola junction	85.814226	27.214222

3.2.5 Phulbari sub-watershed

Phulbari sub-watershed is located within hydrological boundaries of ward no. 4 and 5 of Marin Rural Municipality. However, these wards are not exclusively part of the Phulbari sub-watershed as while ward no. 5 overlaps with the Ghagar sub-watershed. This sub-watershed covers a total of 7237.41 ha and extended from 245 msl to 645 msl. This sub-watershed area also includes lot of river and streams as well as about 78.66% forested land.

3.2.5.1 Socio-economic conditions

3.2.5.1.1 Demographic Characteristics

Since the population data is reported at ward level in Census report, the demographic analysis of the sub-watershed has been done at ward level. The total population in these two wards in the sub-watershed is 7,234 (male 3,527 and female 3,707) with a total households of 1,597. The average household size is 4.54, which has declined from 5.63 in 2011. The average annual population growth rate ranges from -0.08 in ward no. 4 to -0.02 in ward number 5. Both wards indicate a very low negative growth. The sex ratio ranges from 93.2 in ward 4 to 98.2 in ward 5. The major ethnic groups are Tamang, Majhi, Dalits, Chhetri, Brahmin, Hayu, and Magar. . The major settlements in the sub-watershed are: Jutepani, Pahari khola, Pari Jutepani, Kauhare Khola, Pari Khola, Aadhasara, Utdi Bhanjyang, Khayer Khola, Phulbari, Lamedamar, Khaparsal, Budule, Suke Jyamire, Moka Khola, Jyamire, Saat tale, Bhadarachan, Gangate Danda, Mangali Khola, Moruwa Khola, Maruwa, Sahan, Pashupati, Kaugare, Sal ghari, and Marup.

Migration has become an integral part of social process and is reflected in absentee population data of the Census. Out of the total households in these two wards, 629 (39.38%) households have absentee member in the family. A total of 1,266 (17.50%) people are absent in these wards. Out of the total absentee population 66.19% are male and 33.81% are female. The figures of absentee population include both living within the country and abroad. Usually, the people migrated abroad are engaged in foreign employment. A total of 347 (21.73%) households have family member living abroad. Specifically, within-country absenteeism includes 13.39% males and 10.27% females, while abroad absenteeism includes 10.08% males and 1.29% females.

3.2.5.1.2 Agriculture and livestock

The livelihood of communities in the Phulbari Sub-Watershed primarily depends on agriculture, livestock farming, and income from foreign employment, which significantly contributes to household economies. Major crops include paddy, wheat, maize (both hybrid and local), millet, lentils, beans, potatoes, tomatoes, and cabbage. Horticultural crops such as mango, litchi, guava, banana, citrus, and jackfruit are grown mainly for subsistence.

In Khayersal, the adoption of hybrid maize has led to increased pest issues, prompting the use of Integrated Pest Management (IPM) techniques for both hybrid and local varieties. While marshland farming is currently absent, areas like Phulbari, Moka Khola, Dobhan, and Khor Patre Dadeli hold potential for future expansion. In Sahan Chowk, although commercial farming is still limited, households cultivate fruits such as mango, jackfruit, and litchi. Most agriculture remains rainfed, with only limited irrigation support from canals—many of which dry up during winter and the dry season. However, in Khayersal and parts of Sahan Chowk (e.g., Gagane Hamlet), functioning irrigation systems allow for the cultivation of winter crops like hybrid maize.

Livestock farming is a vital part of the local economy, with households raising goats, cows, buffaloes, pigs, and poultry. Controlled grazing has helped minimizing crop damage and livestock-related conflicts. In Khayersal, butter is occasionally sold, although milk production remains non-commercial. In Sahan Chowk, oxen have largely been replaced by hand tractors, and a local dairy service facilitates milk collection. Fodder management is actively promoted by local governments and CFUGs. Species like Jai, Napier, Mendula, and Barsim have been planted in Khayersal, while in Sahan chowk, fodder is mainly collected from community forests.

3.2.5.1.3 Institutions

The Phulbari sub-watershed is served by a range of community-based institutions that support natural resource management, local development, and livelihood improvement. The CFUGs are the most prominent institutions across all settlements, playing a central role in forest governance and resource mobilization.

In Khayersal, institutions such as Mother Saving Groups, Sahas Laghubitta (microfinance institution), and a Community Irrigation Center work alongside CFUGs to support financial access for women, promote savings and credit practices, and manage irrigation infrastructure. There is comparatively limited community-based organizations in Jutepani area, with CFUGs being the main functional body responsible for managing forest. Whereas, In Sahan Chowk, a broader institutional framework is in place. Active bodies include the Marin Phulbari Irrigation Management Committee, Drinking Water Management User Group, Farmer’s Groups, Mother/Women’s Groups, and Tol Development Committees in addition to CFUGs.

3.2.5.2 Biophysical

3.2.5.2.1 Land use and land cover

The forests (65.30%) make up the majority of the sub-watershed's land use and land cover followed by agriculture (20.97%), sand (12.48%) and waterbodies (0.90%).

Table 9 Land use land cover of Phulbari sub-watershed

Landuse/Landcover	Area (Ha)	Percentage (%)
Barren Land	18.70	0.26
Built-up area	0.95	0.01
Bush	1.40	0.02
Cliff	3.40	0.05
Cultivation	1518.00	20.97
Forest	4726.07	65.30
Sand	903.51	12.48
Waterbody	65.37	0.90
Total	7237.41	100.00

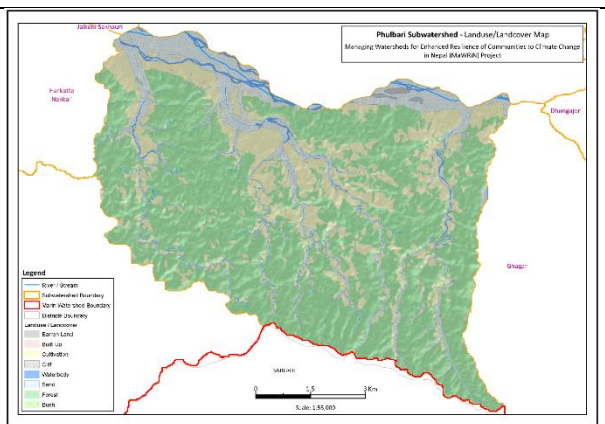


Figure 14 Land use land cover map of Phulbari sub-watershed

3.2.5.2.2 Forest and wildlife

The type of forest in the area is sub-tropical and tropical with common tree species of Sal (*Shorea robusta*), Khayar (*Senegelia catechu*), Sissoo (*Dalbergia sissoo*), Asna (*Terminalia tomentosa*), Karma (*Adina cardifolia*), Chanp (*Michelia champaca*), Simal (*Bombax cieba*), Jamun (*Syzygium cumini*), Botdhayero (*Lagerstroemia parviflora*) and bamboo (*Dendrocalamus spp.*). Local communities have reported a noticeable decline in native tree species like Sal (*Shorea robusta*) and Katus (*Castonopsis indica*). In addition to their ecological significance, these forests support diverse wildlife; frequently reported species of Wild Boar, Jackal, Monkey, Porcupines, Squirrel, Parrots, and occasionally Leopard. There is national forest, community forest, leasehold forest and private forest under the jurisdiction of DFO. There is a total of 11 CFUGs within the sub-

watershed. Major CFUGs include Sungava, Pashupati, Hariyali (Sahan Chowk); Laligurans, Makhamali, Samjhana, Jyamire, Phulbari, Janakalyan, and Janasewi (Khayarsal); and Netrakali CFUG (Jutepani).

These forests provide essential resources such as timber, fodder, grasses, and leaf litter and they remain central to sustainable forest management and local livelihoods. Timber and firewood are distributed at subsidized rates, and CFUGs in Khayarsal manage funds up to NPR 15 lakhs, part of which is used for local development, including education. Most households rely on LPG, reducing firewood dependency. Forest fire monitoring using drones has been introduced in Jutpani. However, challenges such as disputes over forest boundaries (e.g., in Khayarsal) and reduced forest guard presence in Sahan Chowk highlight the need for continued institutional support.

3.2.5.2.3 Water resources

The Phulbari sub-watershed is intersected by several streams and kholas that serve as key sources of water for domestic use, agriculture, and ecosystem support. However, the availability and reliability of these water sources vary across settlements, and many face seasonal scarcity and hazards such as flooding and erosion.

In Jutpani, the major streams include Phulbari Khola, Kaugare Khola (a seasonal source), Jimdar khola, Aapo khola, and Pahari Khola, which becomes hazardous during the rainy season due to sudden high flows. Drinking water is primarily sourced from wells, and a conservation pond developed inside the community forest by the Division Forest Office (DFO), Marin has had a positive impact on water retention and ecosystem services.

In Khayarsal, significant streams include Khar khola, Phulbari Magani khola, and Moktan khola. Drinking water is managed through localized sources such as Makhamali and Phulbari springs. Two ponds—Janakalyan and Phulbari—exist but are currently silted or buried. The Phulbari khola is known to cause flooding, damaging adjacent agricultural land, while the Dobhan area is reported to be deeply eroded and filled with sediment. In addition to water resource concerns, local households collect sand, stones, and boulders from these streams for personal household use, although no commercial extraction is practiced.

In Sahan Chowk, several seasonal streams flow through the area, including Kaugare, Maruwa Khola, Phulbari, Sahani, Bathe Khola, Guyursi Khola, Halit Khola, Charghare/Dhungeti khola, and Parsai and School Khola. However, there is no reliable year-round water source. In Pashupati CFUG, water sources are absent, while small natural springs and a man-made pond are present in the remaining two CFUGs of the settlement.

According to local residents and local government representatives, long dry spell and erratic rainfall along with haphazard construction of rural motorable road using dozers and excavators are

affecting water sources. The FGD and KII reported that traditional ponds, wetlands, riparian area and water sources in upper chure are drying up and thereby reducing the yield.

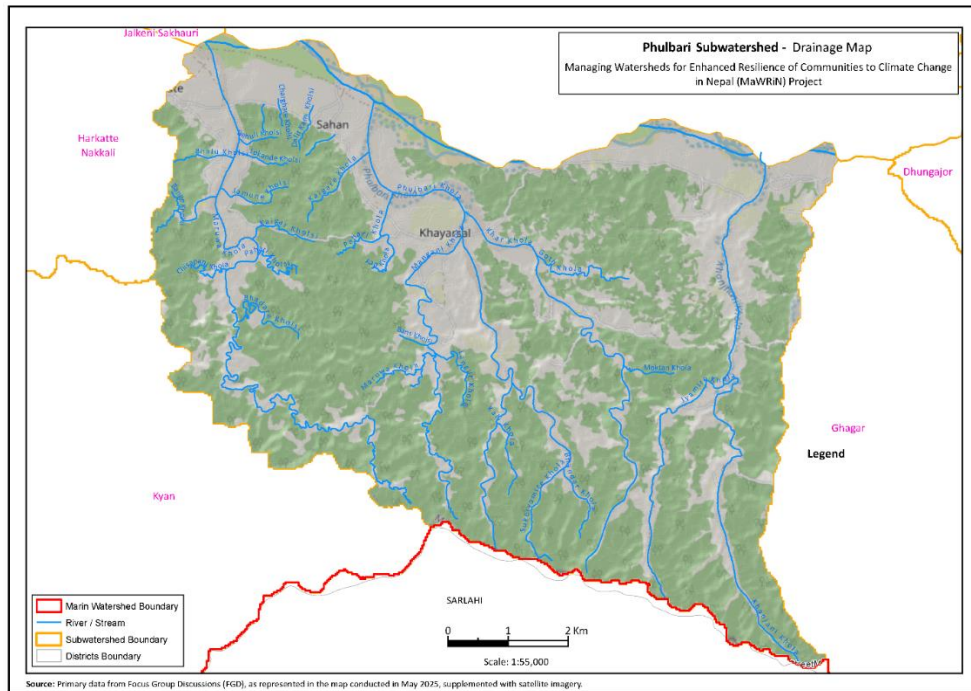


Figure 15 Streams, rivers of Phulbari sub watershed

3.2.5.3 Vulnerable and Priority Sites

3.2.5.3.1 Major Hazards

Phulbari sub-watershed is also highly vulnerable to multiple climate-induced hazards such as flood and river cutting, forest fires, and prolonged droughts. These hazards have intensified in recent years, threatening the ecological integrity of the sub-watershed area and the livelihoods of indigenous and local communities residing in the area.

Vulnerable and Priority Sites/Communities

Landslide-prone areas: Sahan is affected by landslides.

Flood-prone areas and river cutting areas: The flood, river cutting and sedimentation are the key issues that disrupt livelihoods and degrade natural systems. The key rivers and streams of Phulbari sub-watershed area are Phulbari khola, Kaugare khola, Jimdar Khola, Langur khola, Aapo khola, Pahari khola, Khar khola, Magani khola, Moktan khola, Maruwa khola, Sahani khola, Bathe khola, Guyursi khola, Halit khola, Charghare/Dhungeti khola, Parsai khola. The area like Badiman, Ghat, Beteni (Jamini Devi CF and Panchakanya CF), Ampchaur, Jutpani, Paharigaun, Saattale, Mangani Sir located at Phulbari khola, the confluence of Maruwa khola upto Pahari khola (Pashupati CF), confluence of Bans khola, Langur khola, Maruwa khola are the major hotspots for

flooding, riverbank cutting and sedimentation. Farmlands and settlements along these rivers/streams are especially at risk during heavy rainfall in upstream regions.

Forest fire-prone areas: All forested and community forest areas within Phulbari sub-watershed are vulnerable to forest fires, particularly during the dry season. The forest fires significantly impact forest health, biodiversity, and ecosystem services.

Human-Monkey-Parrot-Peacocks Conflict: Most of the areas within the watershed area have been complaining that they are suffered from crops, vegetables and fruits damages by Monkey, Parrots and Peacocks.

Marginalized communities: The highly marginalized ethnic groups like Hayu are inhabited in Suke Jyamire and Bhandarchan. Another marginalized ethnic group – Majhi – is settled down in Khaparsal. However, Dalits area spread over the sub-watershed area. However, they are more concentrated in Khayer khola and Phulbari. These communities are particularly vulnerable to the combined impacts of climate-induced hazards and socio-economic marginalization. By recognizing and addressing the unique challenges faced by the Hayu, Majhi and Dalits communities, the project can foster a more inclusive and equitable society within that sub-watershed area.

Riverbank erosion (river cutting) is a widespread issue across the sub-watershed. In Sahan Chowk, streams such as Lokande, Jamune, Baugau, Pahari, Bhaure, Dhungre, Nyureni, Tipsapi, Thunge, Tallo Bangi, and Bhalu khola have been reported to damage surrounding land and threaten settlements. Similarly, in Khayarsal, Phulbari, Khahare khola, and Mangani khola frequently erode agricultural land. Jutpani also experiences significant erosion, alongside seasonal flooding, landslides, and sediment deposition, particularly during the monsoon.

Forest fires are another major hazard, notably in Sahan Chowk, where a large fire in Maruwa Basti in 2067 BS affected 17 households. Although training on firefighting tools has been provided, fire risk remains, especially during the dry season. In Khayarsal, fires often spread from nearby Sarlahi District, posing risks to forests and settlements. Uncontrolled grazing, particularly in forest and upland areas of Khayarsal, has further degraded land, increasing susceptibility to erosion and reducing natural regeneration.

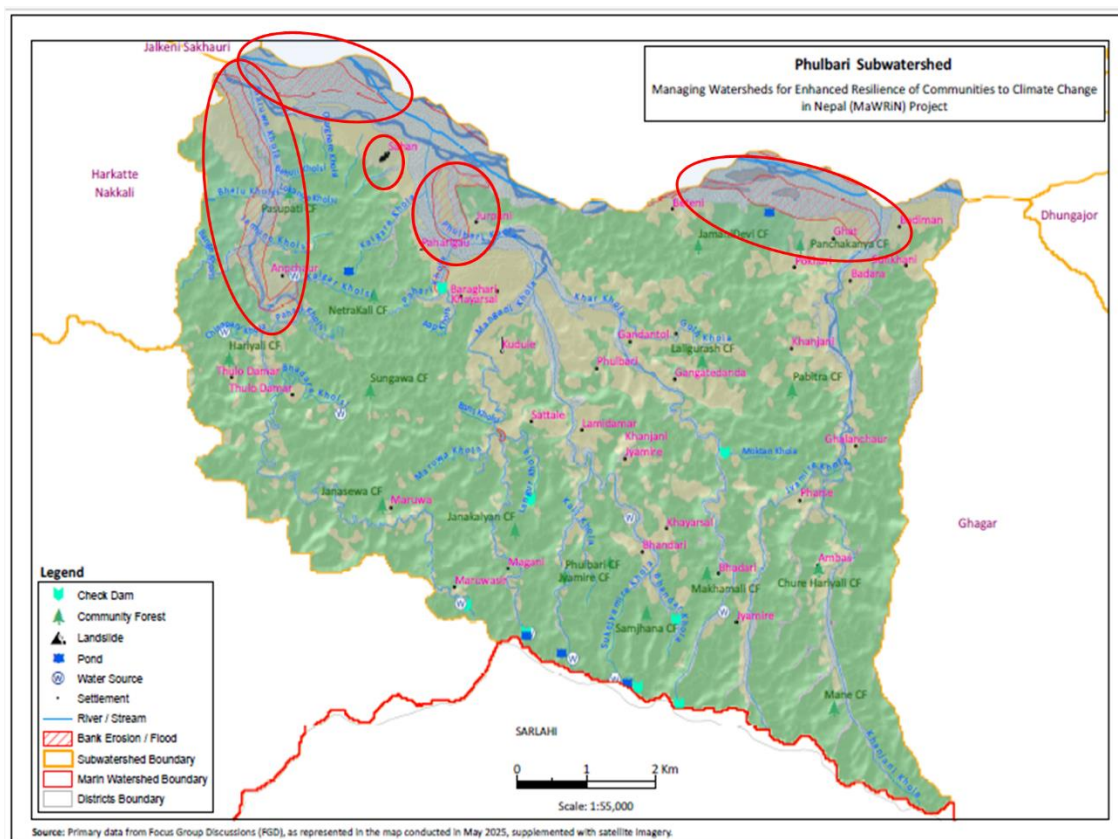


Figure 16 Assessment of vulnerability in Phulbari sub watershed

3.2.5.4 Integrated Adaptation Activities

Based on comprehensive biophysical, socio-economic, and hazard assessments conducted across sub-watersheds have been identified to address the interconnected challenges of climate change, environmental degradation, and livelihood vulnerability. These activities aim to strengthen ecosystem resilience, enhance the adaptive capacity of local communities, and promote sustainable watershed management through nature-based solutions (NbS) and participatory approaches. The list of activities with the proposed sites are illustrated in following Table 10.

Table 10 Integrated adaptation activities with XY coordinates

SN	Activities	Sites	GPS Co-ordinates	
			X	Y
1	Sustainable Forest Management			
1-1	Renew Operational Plan	All CF		
1-2	Sustainable Forest Management Training	All CF		
1-3	Maintenance of Fireline	All CF		

1-4	Cutting and weeding for forest fire control	CF		
1-5	Plantation of fruit trees like Kimbu in the CF	CF		
1-6	Plantation	Barren Land		
1-7	Plantation of Bamboo and Broom Grass	Banks of rivers		
2	Water Source Management			
2-1	Pond construction	Panchakanya Pokhari, Beteni	85.763974	27.248836
		Sukejyamire khola shir	85.743817	27.190116
		Phulbari shir	85.734215	27.193839
		Magani shir	85.728993	27.195941
		Anpchaur	85.702537	27.240932
2-2	Water pond conservation/maintenance (existing)	Jimba Pokhari, Dhare khola, Lekhtol Pokhari Maintenance, Phulbari CFUG		
2-3	Construction of well	Pakhrin khola		
2-4	Drinking Water Project	Taukedanda (Maruwa kanda)		
3	Climate Resilient Agriculture Practices			
3-1	Irrigation Canal	Pahari khola, Simal Damar kulo	85.714293	27.243712
		Kaigare khola Jutpani	85.711308	27.251051
		Mangani - Khar khola	85.723989	27.241862
3-2	Irrigation Canal Maintenance	Sindure CFUG, Sete khola, Bagbangi, Mungre khola, Sarpe khola, Shikar kulo, Daregaudi, Ratmata, Hile khola		

3-3	Support for Women-Friendly Agricultural Tools	Selected CFUG members		
3-4	Tunnel Farming	All		
3-5	Cardamom Farming			
3-6	Improved seed support/Seed Center Establishment	All		
3-7	Organic farming/IPM technology	All		
3-8	Mushroom Farming	All		
3-9	Fruit plants support – Mango, Litchi, Citrus/Lemon, Avocado, Pineapple, Jackfruit, Banana	All		
4	Improved Livestock Management			
4-1	Support for improved breed of livestock(goat) farming	All		
4-2	Grass and fodder cultivation for livestock	All		
4-3	Improved livestock shed	All		
4-4	Support for Artificial Insemination	All		
5	Nature Based Solutions			
5-1	Embankment and Bio-engineering	Aap khola - Pahari khola junction	85.717007	27.238932
			85.716707	27.238539
		Pahari khola	85.716711	27.240638
			85.715849	27.240408
		Dalit khola	85.703372	27.255703
			85.704083	27.255731
		Mangani khola	85.726850	27.238216
			85.732664	27.238785
		Khar khola	85.732309	27.242051
			85.735917	27.223186
		Suke Jyamire khola, Lamidamar	85.686929	27.259402
			85.689642	27.260415
Langur khola	85.726126	27.220679		
	85.725992	27.220393		
Bhandari khola	85.747498	27.202075		

			85.747920	27.202506
			85.711041	27.253993
		Phulbari khola	85.718065	27.250748
		Phulbari khola, Khayersal	85.727321	27.243803
			85.689626	27.233376
		Chisapani khola	85.689443	27.233241
5-2	Gully control (Checkdam)	Moktan Khola shir	85.757791	27.219001
		Khar khola shir	85.751476	27.187675
		Bhandar khola shir	85.750894	27.198223
		Suke Jyamire khola shir	85.745377	27.189679
		Sattale	85.729466	27.212952
		Magani shir	85.728988	27.196302
		Maruwa shir	85.720207	27.199715
		Pahari gaun	85.716202	27.239099

3.2.6 Kyan sub-watershed

The Kyan sub-watershed lies within the hydrological boundaries of Ward No. 3 of Marin Rural Municipality and Wards No. 6, 7, and 8 of Hariharpurgadhi Rural Municipality. It spans an area of 15,676.52 hectares, with elevation ranging from 145 meters to 636 meters above sea level. The area is characterized by numerous rivers and streams, and approximately 78.66% of the land is covered by forest.

3.2.6.1 Socio-economic conditions

3.2.6.1.1 Demographic Characteristics

As population data in the Census is reported at the ward level, demographic analysis for the Kyan sub-watershed has also been conducted accordingly. The combined population of the four relevant wards within the sub-watershed is 13,031, comprising 6,376 males and 6,655 females, across 2,710 households. The average household size is 4.81, a decrease from 5.82 in 2011. The annual population growth rate varies across the wards, ranging from -2.36% in Hariharpurgadhi Ward 6 to 0.34% in Marin Ward 3, the only ward in the area showing positive population growth.

The sex ratio ranges from 91.36 in Hariharpurgadhi Ward 7 to 99.15 in Marin Ward 3. The predominant ethnic groups residing in the sub-watershed include Tamang, Majhi, Magar, Rai

(Danuwar), Dalit, Brahmin, and Chhetri communities. Major settlements within the Kyan sub-watershed include Purana Gaun, Pathrai Tallo, Pathrai Mathillo, Bal danda, Lampate, Pathchouri, Kunda, Siru danda, Bachatar, Dhumbe, Kawan Chuli, Ghumaune, Andheri, Bhutaha, Ramja, Bhitri Sitol, Majhi Danda, Haijora, Simal Damar, Rani Parada, Sitol, Ghopte, Khepuwa, Dhoka khola, Jarayo Tar, Dhoka Dobhan, Sistori Majhi Tol, Pari Parada, Ajing Sukhoua, Chaskat, Bhalayo Tol, Poudel Tol, Pani Ghat, Inar Tol, Bhalayo Bhitri Tol, Fouwar Kanda, Sano Deuta Khola, Thulo Deuta khola, Kadam Kholsi, Jyamir Mungre, Thakouli khola, Sano Deunata Khola, Thulo Deunata khola, Sano Kauwa, Thulo Kauwa, Bhiman, Jhapsi, Morung, Lekhtole, Aamp danda, Harbale, Sirutaar, Jalebi Dobhan, Kunitung, Sano Kuwa (Khola Pari), Jalevi Chu, Bhanjyang Pakha, Teenparta, Dhaksha, Amla Damaar, Rage Dobhan, and Beshi Tol.

Migration plays a significant role in the social dynamics of the area and is evident in the absentee population figures reported in the Census. Among the total households in these wards, 893 (32.96%) have at least one absentee family member, amounting to 2,902 individuals or 22.27% of the population. Of these, 1,610 (28.42%) are males and 1,292 (19.42%) are females. This includes both domestic and international migrants, with foreign migration primarily driven by employment opportunities. A total of 384 households (14.16%) have family members living abroad. Specifically, domestic absenteeism accounts for 1,541 males (24.17%) and 1,361 females (20.46%), while international absenteeism is comprised of 59.79% males and 40.21% females.

3.2.6.1.2 Agriculture, livestock and livelihood

The primary sources of livelihood in the Kyan sub-watershed are agriculture, livestock farming, and foreign employment. Most households are still practicing subsistence farming whereas, some gradually shifting toward semi-commercial production. The main crops cultivated across the region are paddy, wheat, maize, millet, pulses, oilseeds and vegetables. The common fruit bearing crops include mango, litchi, guava, banana and citrus fruits etc. Vegetables such as potatoes and watermelons (bagare kheti) are also grown, particularly in Kyaneshwor and Rage Dobhan, where some farmers have begun commercial-scale of production following road access improvements.

Irrigation practices vary across the watershed. In Kali Dobhan and Rage Dobhan, water is lifted using motor pumps, with some support provided by the local level. Specific areas such as Chisapani Daksar, Ramandas, Kudule, Khayer Sal, and Gagane Tol have developed localized irrigation systems, although functionality remains an issue in certain places like Poudel Tar in Barun. The pest outbreaks in maize, rice, and millet have increased over the past four to five years, resulting in 75% of farmers using pesticides for weed and pest control. Farmers here also lack climate-resilient seeds, shortage of human resource, lack of improved technology, infestation of crop by disease and pest compounding their vulnerability.

Livestock is another component of livelihood in the sub-watershed which is of subsistence in nature. The common domestic animals are local Goat, Cow, Buffalo, Pig and poultry for milk and dairy products, meat, eggs, and agriculture purposes. The number of livestock has decreased in some areas, with stall-feeding practices gradually increasing. Open grazing of livestock mainly by goats, cows, and buffaloes is widely practiced throughout the community forests while buffaloes are kept near riverbanks (bagars). Some households in Kali Dobhan and Kyaneshwor have improved livestock sheds, supported by external projects with grants of up to NPR 14,000. Fodder grasses like Napier and Epil epil, as well as fodder trees, have been planted in small numbers across the sub-watershed. Artificial insemination in cattle and buffaloes is practiced in areas with access to veterinary services, typically provided by local ward offices.



Photo 13: Livestock Grazing in Kyan

3.2.6.1.3 Institutions

Several community-based institutions exist across the Kyan sub-watershed, playing important roles in resource management, social organization, and local development. The most prominent among these are Community Forest User Groups (CFUGs), which are active in all major areas and are instrumental in the management and conservation of forest resources.

In Rage Dobhan, both Community Forests and active Mother Groups are functioning, contributing to forest protection and social mobilization. Similarly, Kyaneshwor hosts a mix of local institutions including CFUGs, farmers' groups, and a savings group, although the local women's or mother groups are currently inactive. In Kali Dobhan, women's groups were formed in the past but are no longer active, indicating a gap in consistent community engagement and gender-focused organization in the area.

3.2.6.2 Biophysical

3.2.6.2.1 Land use and land cover

The land use land cover classes in the sub watershed are as in the table. Out of the total area, forests make up the majority of the sub-watershed's land use and land cover (78.66%), followed by agriculture (17.72%), sand (2.52%) and water bodies (0.89%).

Table 11 Land use land cover of Kyan sub-watershed

Landuse/Landcover	Area (Ha)	Percentage (%)
Barren Land	30.20	0.193
Bush	0.76	0.005
Agriculture	2777.75	17.719
Forest	12331.40	78.662
Grass	0.39	0.002
Pond	1.74	0.011
Sand	394.97	2.519
Waterbody	139.31	0.889
Total	15676.52	100.00

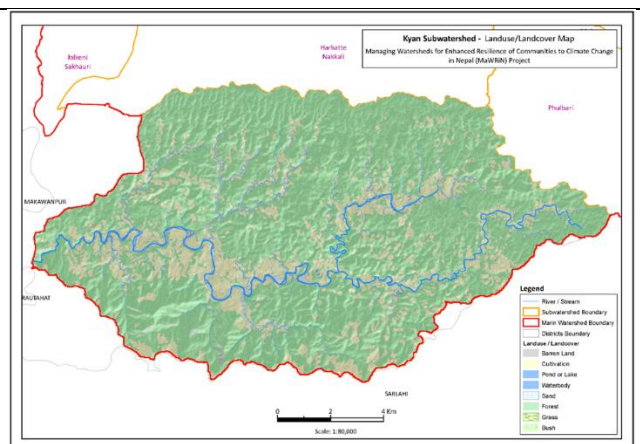


Figure 17 Land use and land cover map of Kyan sub watershed

3.2.6.2.2 Forest and wildlife

The type of forest in the area is sub-tropical and tropical with common tree species of Sal (*Shorea robusta*), Khayar (*Senegelia catechu*), Sissoo (*Dalbergia sissoo*), Asna (*Terminalia tomentosa*), Karma (*Adina cardifolia*), Champ (*Michelia champaca*), Simal (*Bombax cieba*), Jamun (*Syzygium cumini*), Botdhayero (*Lagerstroemia parviflora*) and bamboo (*Dendrocalamus spp*s). In addition to their ecological significance, these forests support diverse wildlife; frequently reported species include Wild Boar, Jackal, Deer, Monkey, Porcupines, Squirrel, Peacocks, Parrots, and occasionally Leopard.

There are national forests, community forests, leasehold forests and private forests under the jurisdiction of DFO. There is a total of 43 CFUGs within the sub-watershed. These forests provide essential resources such as timber, fodder, grasses, and leaf litter and they remain central to sustainable forest management and local livelihoods. Local communities have reported a noticeable decline in native tree species like Sal (*Shorea robusta*) and Katus. NTFPs like Tama, Kurilo, Harro, Barro, Amala, Babiyo, and broom grass are collected primarily for household use, with limited local trade. In some areas, such as Kyaneshwor, sal leaves are also harvested and sold. Livestock grazing remains a common practice in the community forests, especially involving goats, cows, and buffaloes. However, reliance on forest resource has gradually declined, mainly fuelwood, due to the increasing adoption of LPG and a reduction in livestock numbers. Whereas, human-wildlife conflict is a persistent problem all over the sub-watershed, posing additional challenges for forest-dependent communities.

3.2.6.2.3 Water Resources

The major perennial streams such as Saag khola, Kyan khola, Pathrai khola, and Dhare khola are critical water sources within the watershed. Other important streams include Thude khola, Thulo Deuta khola, Bhalayo khola, Raman khola, Kalwan khola, Dhoka khola, Mul khola, Dhad khola, Ramchuwa, and Deuta khola, among many smaller jhoras like Kakhare, Hile, Dhumbe, Pandere, Bimire, Lama, and Chhyangchhange. These water bodies are scattered across key settlements such as Kali Dobhan, Barun, Rage Dobhan, and Kyaneshwor, providing water for multiple uses. Natural ponds are also found in areas such as Dhumbe khola (Pathrai Community Forest), Dharekholi, Jimba khola, Bhalayo Bhitri, and Falchoure Pokhari. These ponds offer supplemental water storage, especially valuable during dry periods. Drinking water in the sub-watershed is primarily sourced from nearby streams and jhoras such as Ginderi, Kakhare, Hile, Haldaar, Lama, and Chhyangchhange. However, during the rainy season, water contamination is a recurring problem, and residents frequently report not having access to clean drinking water.

In Kyaneshwor, the Kalyan River is considered the main watercourse flows through the area from head to toe. While it serves as a vital resource, the ongoing extraction of sand and gravel from the riverbed has led to its deepening, which may threaten long-term hydrological stability and groundwater recharge. According to local residents and local government representatives, long dry spell and erratic rainfall along with haphazard construction of rural motorable road using dozers and excavators are affecting water sources.

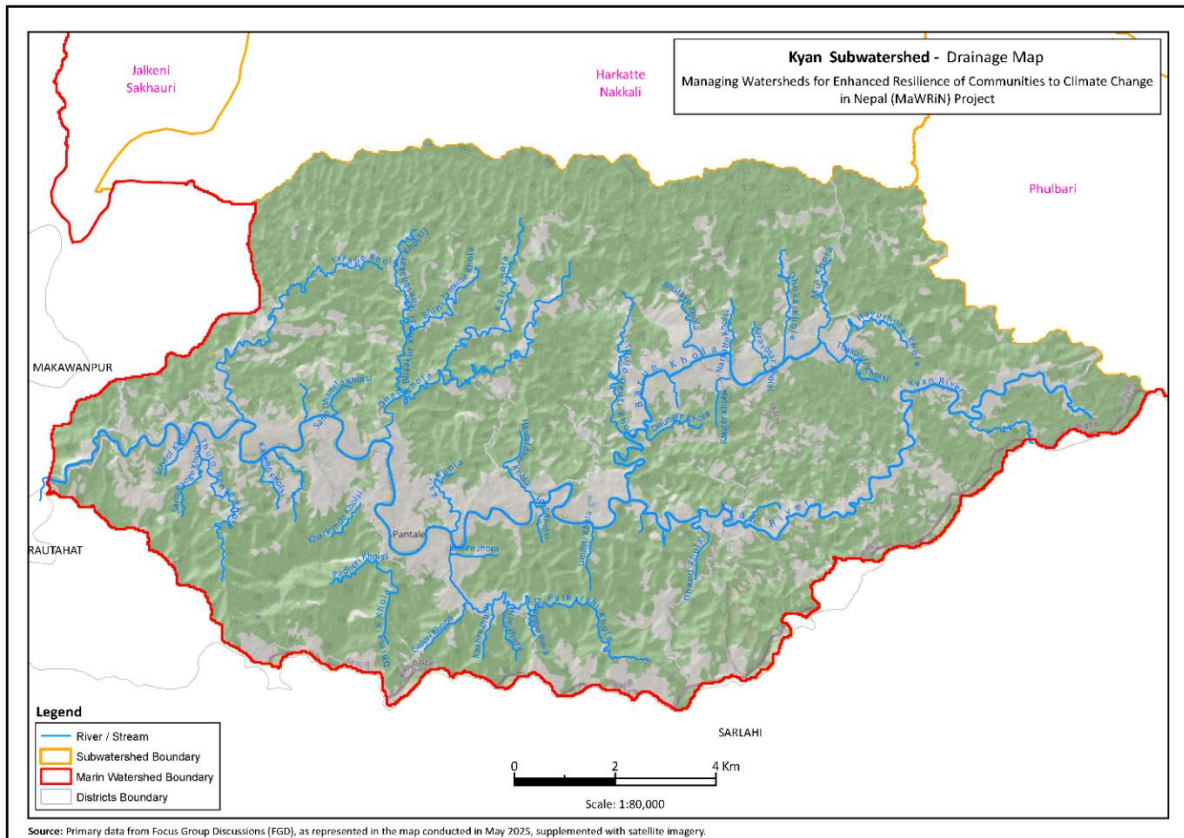


Figure 18 Streams, rivers of Kyan sub watershed

3.2.6.3 Vulnerable and Priority Sites

3.2.6.3.1 Major Hazards

Based on a participatory assessment (including field observations and focused group discussions), along with GIS mapping, the primary hazards identified in the Kyan sub-watershed include landslides, riverbank cutting, floods, and forest fires.

Vulnerable and Priority Sites/Communities

- Landslide-prone areas:** The community forests, such as Bhumeswar CF, Bharmathakur CF, Siddhakali CF, Bhaluchure CFUG, Patharai CF and Kebanchuli CF located in the Kunda Danda, Dhimile Danda, Kharkhande, Rangechuri, Sano Kauwa, Chhangchhang khola are significantly affected by landslides. The landslides itself have severely damaged ecosystems, agricultural lands, and infrastructure. Similarly, it has impacts in the downstream sites.
- Flood-prone areas and river cutting areas:** The flood, river cutting and sedimentation are the key issues that disrupt livelihoods and degrade natural systems. The key rivers and streams are Sag khola, Kyan khola, Pathari khola, Ghatte khola. The area like Sishau Damar, Siundidamar, Jorsimal, Moktan danda, Majhi danda, Dhoka Sisneri, Barun gaun, Laharin, Kali dobhan, Patharai, Chisapani, Kans Bhakar, Kuber Dada gaun, Ramchuha,

Beshi tol are the are major hotspots for riverbank erosion and sedimentation. Farmlands along the Kyan River are especially at risk during heavy rainfall in upstream regions.

- **Forest fire-prone areas:** All forested and community forest areas within Kyan sub-watershed are vulnerable to forest fires, particularly during the dry season. The forest fires significantly impact forest health, biodiversity, and ecosystem services.
- **Human-Wildlife Conflict:** Most of the areas within the watershed area have been complaining that they are suffered from crops, vegetables and fruits damages by monkey, wild boar, porcupine and parrot.
- **Barren land:** Area like Jamuneparta and Chisapani have the barren land where plantation can be done focusing on the high value and fast-growing forest species.

These hazards have intensified over time, posing serious threats to the ecological integrity of the Chure landscape and the livelihoods of Indigenous and local communities living in the area.

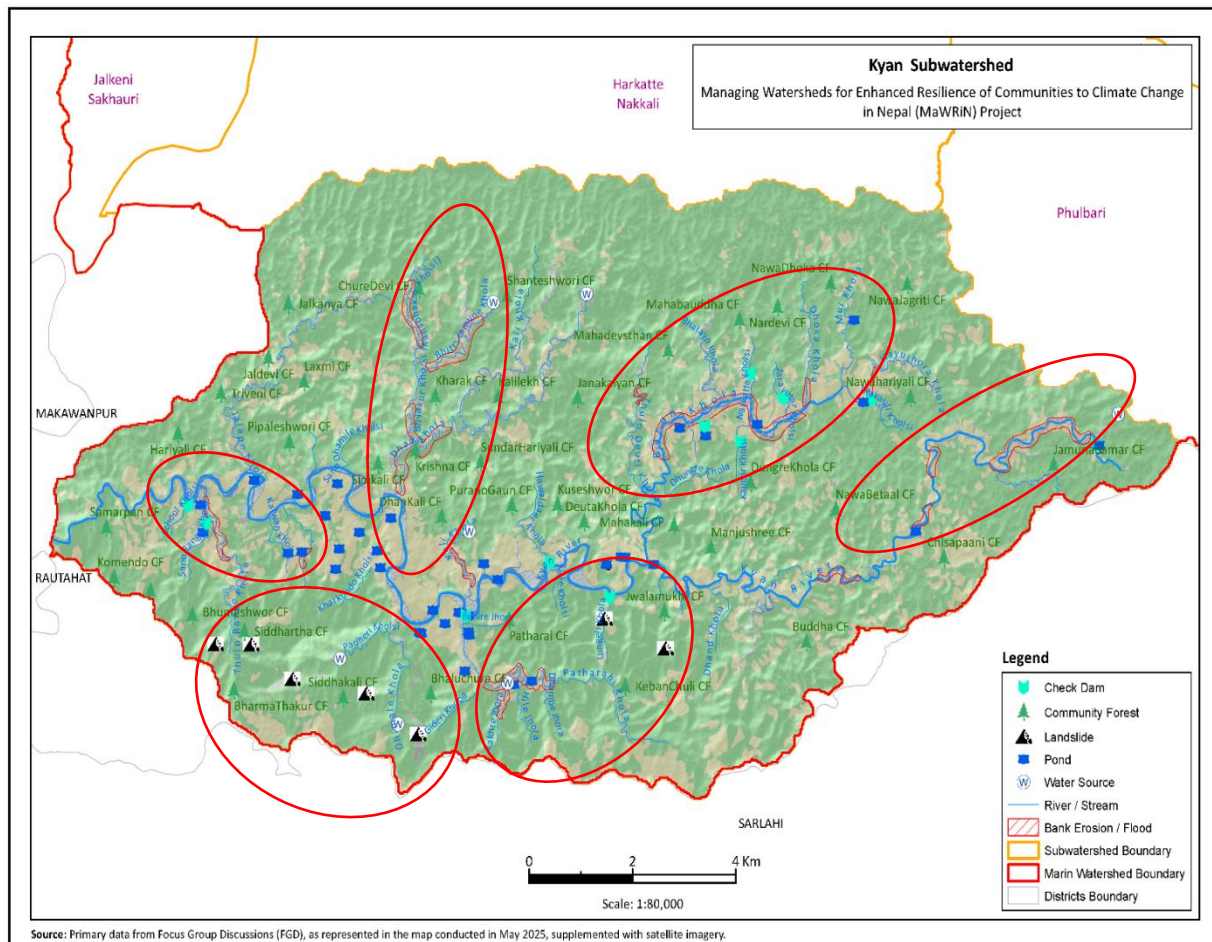


Figure 19 Assessment of vulnerability in Kyan sub watershed

3.2.6.4 Integrated Adaptation Activities

During the assessment, the FGD participants and stakeholders discussed and identified, a range of integrated and community-driven adaptation interventions have been identified to address the interconnected challenges of climate change, environmental degradation, and livelihood vulnerability. These activities aim to strengthen ecosystem resilience, enhance the adaptive capacity of local communities, and promote sustainable watershed management through nature-based solutions (NbS) and participatory approaches. The list of activities with the proposed sites are illustrated in following Table 12.

Table 12 Integrated adaptation activities with XY coordinates

SN	Activities	Sites	GPS Co-ordinates	
			X	Y
1	Sustainable Forest Management			
1-1	Forest Management	All CFUGs		

1-2	Support for equipment and awareness program for forest fire control	All CF		
1-3	Drone monitoring for forest fire control and illegal activities	All CFUGs		
1-4	Plantation	All CGUGs		
2	Water Source Management			
2-1	Pond construction	Kyansir	85.70944	27.19433
		Sri tol	85.66319	27.20081
		Bhitri	85.64249	27.19705
		Laharin	85.62736	27.19631
		Patharahi	85.59890	27.15570
		Tilbari	85.58634	27.16597
2-2	Water pond conservation/maintenance (existing)	Lekhtole Pokhari	85.53426	27.17877
		Mathillo Patharai	85.59539	27.15511
		Jimba Pokhari, Dharekholi		
2-3	Drinking Water	Ginderi Jhora in Tallo Pathrai	85.584943	27.161599
		Tauke Danda (Maruwa Kada) Drinking water Scheme Kyaman Chuli, Mathillo Pathrai		
2-4	Well construction	Pakhrin khola		
3	Climate-Resilient Agriculture Practices			
3-1	Irrigation Canal	Gairi khola CFUG, Mrige dobhan, Thing khola, Siddhakali, Lopchana Tol, Sundar Hariyali,		
		Kali khola	85.587441	27.169640
		Bhumeshwor CF	85.541124	27.172754
		Lekhtol	85.522991	27.176044

		Patharahi	85.591808	27.156270
		Hawaldaar khola, Puranogaun	85.598657	27.176978
		Lungeli khola	85.614706	27.168300
		Kali Dobhan	85.586088	27.170894
		Pantale	85.578761	27.167630
3-2	Tunnel Farming	All areas		
3-3	Improved seed support/Seed Center Establishment	At Palika Level		
3-4	Organic farming/IPM technology	All area		
3-5	Turmeric Farming	Kali Dobhan		
4	Improved Livestock Management			
4-1	Improved Shed Support	All areas		
4-2	Grass and fodder cultivation for livestock	All areas		
4-3	Support for goat keeping	All areas		
4-4	Support for Artificial Insemination	All areas		
4-4	Support for establishing Dairy Collection Center	Plastic Taar		
5	Nature based Solutions			
5-1	Landslide treatment activities, plantation	Chhangchhane	85.629288	27.153124
		Kunda danda	85.617556	27.178943
		Dhimile danda	85.574230	27.141408
		Kharkhande	85.559604	27.148883
		Rangechuri	85.546491	27.147505
		Sano Kauwa	85.553736	27.198048
		Shisaudamar	85.689689	27.195918
		Siundidamar	85.670828	27.182189
		Jorsimal	85.678870	27.187135
		Muktan danda	85.662768	27.178482
		Majhi danda	85.664006	27.205387
		Dhokasisneri	85.647872	27.199241

		Barun gaun	85.636198	27.198152
		Laharin	85.622997	27.197637
		Kali dobhan	85.585490	27.172122
		Patharahi	85.593376	27.156697
		Chisapani	85.562684	27.187452
		Chisapani	85.562684	27.187499
		Kans Bhakar	85.575803	27.214542
		Kuber danda gaun	85.573399	27.202771
		Ramchuha	85.553158	27.173523
		Besitol	85.532091	27.180320
		Jamuneparta	85.577661	27.183236
		Siddhakali CF	85.566165	27.154895
		Sundar Hariyali CF	85.589620	27.189720
5-2	Bio-engineering Practices with Embankment	Siundidamar	85.674311	27.181789
		Jorsimal	85.677831	27.191375
		Muktan danda	85.669058	27.178034
		Majhi danda	85.664822	27.203740
		Dhokasisneri	85.647913	27.198397
		Barun gaun	85.636207	27.200022
		Laharin	85.623069	27.195782
		Kali dobhan	85.586039	27.172082
		Patharahi	85.595390	27.157528
		Chisapani	85.562604	27.186563
		Kans Bhakar	85.574528	27.213084
		Kuber danda gaun	85.574366	27.199269
		Ramchuha	85.554226	27.174075
		Besitol	85.534517	27.182787
5-3	Check dam	Kyansir	85.708862	27.194418
		Sritol	85.664739	27.201163
		Dhokasisneri	85.647559	27.201334
		Ajingar	85.641016	27.205210
		Bhitri	85.639216	27.194339
		Morangi	85.632203	27.196777
		Kunda danda	85.614010	27.169357
		Tilbari	85.585899	27.166068
		Purano gaun	85.602187	27.174701
		Beshi Tol	85.534913	27.180350
		Beshi Tol	85.531326	27.183049

3.3 Demonstration Sites

Demonstration sites in each sub-watershed (Table 13) were identified through community consultations, field observations, and interaction with the Sub-watershed Coordination Committee. The proposed sites were then presented in the municipal and district level stakeholder workshops.

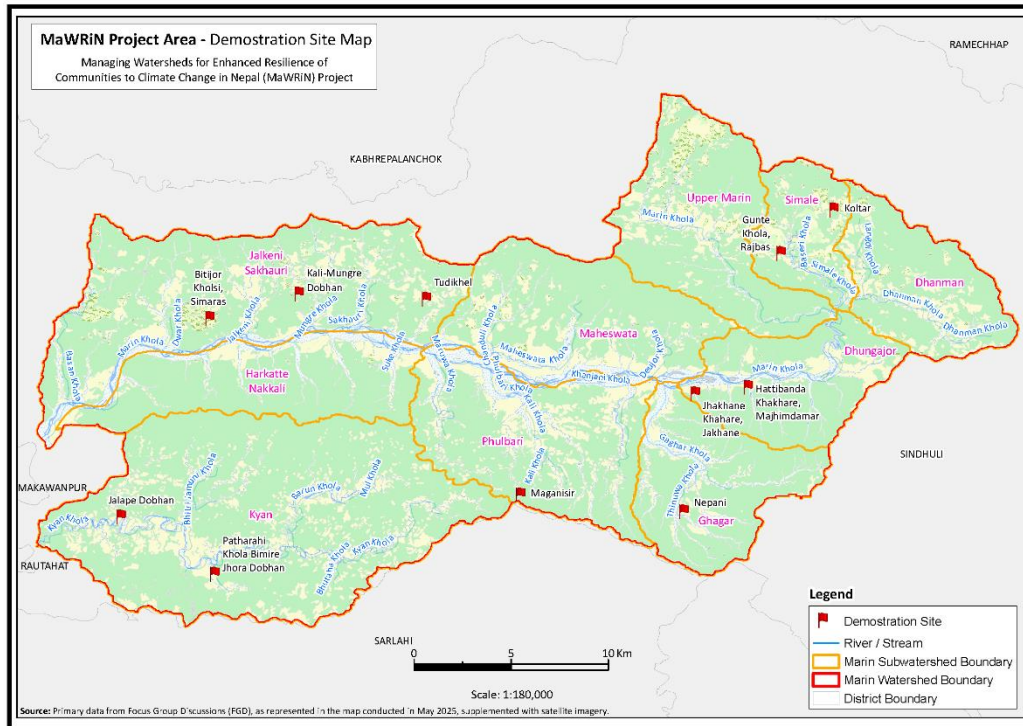


Figure 20 Demonstration sites of the Marin watershed

The purpose of the model sites is to enhance community and ecosystem resilience through the promotion of diversified, climate-smart livelihood options and nature-based solutions (NbS) tailored to the ecological and socio-cultural context of the proposed site. Major selection criteria applied for site selection were:

- (i) Vulnerability to stream/river cutting, landslide, water scarcity etc.
- (ii) Majority of vulnerable and marginalized ethnic groups/population in the area;
- (iii) Potential/need for implementation of multiple activities as identified in the project document;
- (iv) People's willingness to actively participate in and contribute to project implementation;
- (v) Potential for other communities to visit/observe the activities carried out and results in the area.

The issues and concerns are almost similar in all the proposed demonstration sites. Major issues include challenges such as landslides, river/steam bank cutting, flash floods, drought, and forest fire, crop damages by monkey, porcupines, wild boar, parrot and peacocks. Similarly, upstream-downstream linkages are very important aspects to be considered for program implementation.

For developing model sites, MaWRiN Project Management Unit should collaborate with other stakeholders to leverage with provincial and local government's program, community-based organizations like CFUGs and other partners for effective resource mobilization, resource complementarity and synergies in the results.

Table 13 Proposed demonstration sites

SN	Sub-watershed	Proposed site 1			Proposed site 2		
		Name	Coordinates		Name	Coordinates	
			X	Y		X	Y
1	Simle	Gunte Khola (Rajbas and Sukachaur area)	85.84871	27.31138			
2	Dhungajor	Jhakhani Khahare,	85.80902	27.24643	Hattibanda Khakhare, Majhimdamar	85.83349	27.24938
3	Ghagar	Nepane	85.80378	27.19171			
4	Phulbari	Mangani shir	85.72809	27.19945	Aanp gachhi (Chihane to Mathillo basti)	85.68446	27.29022
5	Jalkeni Sakhauri	Kali-Mungre Dobhan	85.62546	27.29261	Bitijor Kholsi, Simaras	85.58411	27.28128
6	Kyan	Jalape Dobhan	85.54299	27.189276	Patharahi Khola Bimire Jhora Dobhan	85.58652	27.16277

4. Implementation Strategies

Nepal's federal structure mandates a multi-level governance system for the management of natural resources and climate change. The implementation of the MaWRiN Project in the Maru Watershed requires coordinated action across federal, provincial, and local governments, technical agencies, and community-based organizations. This section outlines the institutional arrangements, stakeholder responsibilities, and governance mechanisms for effective delivery of the project.

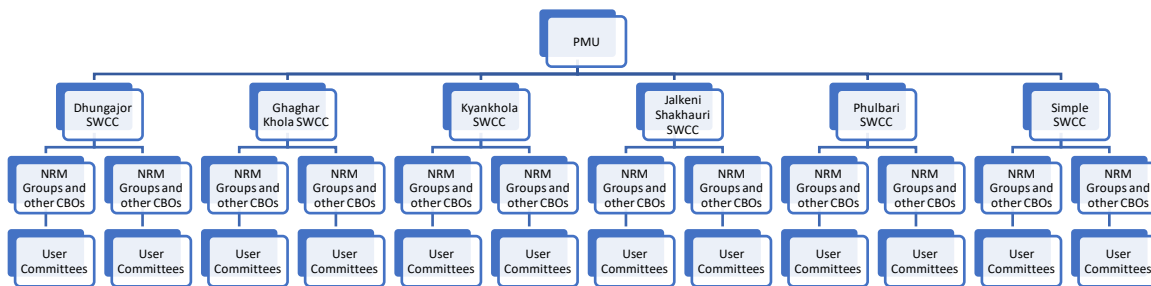


Figure 21 Implementation Strategy

4.1 Government Institutions

4.1.1 Federal Level

At the federal level, the Ministry of Forests and Environment (MoFE), based in Kathmandu, is responsible for providing overarching policy direction, inter-agency coordination, and alignment of project objectives with national strategies and climate adaptation frameworks. MoFE also provides technical backstopping to sub-national bodies and leads institutional capacity-building initiatives and knowledge management efforts. The Ministry of Finance (MoF), acting as the operational and political focal point for the Global Environment Facility (GEF), facilitates the financial channeling of GEF funds to the provincial level and ensures timely disbursement and reporting. The Department of Forests and Soil Conservation (DoFSC) offers technical guidance by developing national standards, methodologies, and protocols for forest and watershed management, and is tasked with oversight of implementation progress across all relevant districts.

4.1.2 Provincial Level

The Ministry of Forests and Environment of Bagmati Province is designated as the lead executing partner for the MaWRiN Project at the provincial level. It assumes the overall responsibility for

strategic guidance, project implementation oversight, and inter-agency coordination within the province. The Ministry may also depute technical staff to support the Project Management Unit (PMU) as needed. The Soil and Watershed Management Office (SWMO) in Ramechhap serves as the primary technical agency for implementation, ensuring the execution of field activities, coordination with provincial line agencies, and engagement with local governments and communities. Sectoral ministries responsible for agriculture, livestock, physical infrastructure, and social development will work in collaboration with project stakeholders to align interventions with existing provincial programs and to provide technical inputs and co-financing support.

4.1.3 District and Local Level

At the district level, Divisional Forest Offices (DFOs) in Marin and Sindhuli districts play a key role in providing technical supervision to Community Forest User Groups (CFUGs), Leasehold Forest Groups (LFGs), and other forest-based grassroots organizations. They are tasked with ensuring the proper implementation of forest management, fire control, slope stabilization, and nature-based restoration measures. Local governments—including municipalities and rural municipalities—serve as crucial actors in embedding project interventions into annual development plans and budgets. They facilitate community mobilization, allocate local co-financing, and oversee project-related service delivery. In parallel, District Livestock Service Office, Agriculture Development Office, District Disaster Risk Reduction and Management Committee, District Coordination Committee, District Administration Office, District Water and Sanitation Office, District Irrigation Office, District Chapter of Indigenous People's Organization (NEFIN), NEWAH (Nepal Water for Health) organization, Marin Sunkoshi Diversion Project, District Federation of Community Forest User Groups of Nepal (FECOFUN) will be engaged to extend technical support, training, and field demonstrations in degraded area restoration, climate-resilient agricultural and livestock practices including climate sensitive infrastructure development.

4.1.4 Community-Based Institutions

Community-based institutions, including CFUGs, LFGs, Water Users' Groups (WUGs), and farmers' groups, mother groups and other functional groups like youth clubs, will lead the implementation of site-specific interventions such as agroforestry, water conservation, slope stabilization, bioengineering, and climate-smart agriculture, awareness raising. These groups will be strengthened through targeted capacity-building in governance, financial management, natural resource management, technical skills, and gender and social inclusion. Their active participation in planning, implementation, and monitoring will ensure that interventions are locally owned, socially inclusive, and aligned with indigenous knowledge systems and traditional practices.

4.2 Project Management and Oversight

The overall governance and oversight of the project are supported through a tiered institutional mechanism. The Project Steering Committee (PSC), chaired by the Secretary of MoFE, Bagmati

Province, serves as the main governing body of the project and provides strategic guidance, approves annual work plans and budgets, and reviews overall project progress. The PSC comprises senior officials from relevant federal and provincial ministries, development partners, and academic institutions, while WWF-GEF serves in an observer role. At the local level, the Project Coordination Committee (PCC), chaired by the District Coordination Committee of Sindhuli, ensures inter-municipal coordination, supervises field-level implementation, and helps resolve operational constraints on the ground. The PCC can also play a crucial role to discuss the program and plans of different municipalities and sectoral agencies so as to complement by avoiding overlapping with project activities and community needs as well as replicate scalable models in other areas and municipalities.

The Project Management Unit (PMU), hosted at SWMO Ramechhap, is the operational body responsible for day-to-day project management. Led by the Chief of SWMO who also serves as the Project Manager, the PMU oversees implementation, procurement, monitoring and evaluation, reporting, and stakeholder coordination. The team comprises experts in forestry, agriculture, engineering, livestock, GESI, monitoring and evaluation, and administrative functions. WWF Nepal supports the PMU through staff recruitment and technical assistance, ensuring compliance with GEF and WWF operational and safeguard policies.

This integrated implementation strategy fosters vertical and horizontal coordination across all tiers of government while empowering community institutions as central actors in climate-resilient watershed management. By combining high-level policy support with grassroots ownership and technical excellence, the MaWRiN Project aims to serve as a scalable model for participatory and sustainable climate adaptation in Nepal's vulnerable landscapes.

4.3 Integrated Field-Level Implementation Approach

The successful implementation of the MaWRiN Project relies on a decentralized, community-driven, and watershed-based coordination structure that ensures locally appropriate and ecologically grounded adaptation interventions. The approach places strong emphasis on participatory governance, multi-level collaboration, and integrated natural resource management.

4.3.1 Watershed-Based Planning and Coordination

The Sub-Watershed Coordination Committee those were recently established by the project serve as the main platform for coordination, oversight, and implementation at the local level. These committees fully act as operational units for managing activities within their respective catchments and serve as the central link between the project's technical institutions and local community-based groups. At the watershed level, these committees can be federated as the Marin Watershed Level Coordination committee by bringing 2-2 representatives from each SWCC. This WCC can link SWCC with project authorities, PCC and other district level stakeholders for effective service deliveries and technical support in the watershed.

To institutionalize accountability and ensure clarity of responsibilities, the project will enter into formal contractual agreements with each of the six Sub-Watershed Coordination Committees in the witnesses of WCC. These agreements can outline the scope of work, financial and operational responsibilities, and expected deliverables. The committees coordinate closely with relevant local user groups, facilitate implementation, and monitor progress on the ground.

4.3.2. Community-Centered Delivery Mechanism

At the grassroots level, field implementation can be carried out through a range of community-based institutions including Community Forest User Groups (CFUGs), Leasehold Forest Groups (LFGs), Water User Groups (WUGs), women's groups, farmers' groups, youth clubs, and other relevant local bodies. These institutions will be responsible for executing interventions related to nature-based solutions, forest management, slope stabilization, water conservation, and climate-resilient livelihoods.

The Sub-Watershed Coordination Committees need to supervise and support these local institutions to ensure that activities are inclusive, well-coordinated, and aligned with community priorities. Special attention needed to be given to the meaningful participation of Indigenous peoples, women, and marginalized populations in all aspects of planning, implementation, and monitoring. Institutional capacity of these groups needs to strengthen through training, awareness programs, and technical backstopping.

4.3.3. Local Government Integration

Municipal and rural municipal governments will serve as key coordinating bodies, responsible for aligning project interventions with local development plans, allocating co-financing resources, and facilitating service delivery. Project activities will be embedded within local planning cycles to promote sustainability and institutionalization. Sectoral offices at the local level—such as agriculture, livestock, forestry, and water—will be mobilized to provide technical oversight and facilitate cross-sectoral collaboration.

4.3.4. Technical Backstopping and Multi-Stakeholder Support

The Ministry of Forests and Environment (MoFE) and the Bagmati Province Ministry of Forests and Environment will provide overall policy direction and technical guidance. Implementation support will be provided by relevant line agencies including the Division Forest Office, the Soil and Watershed Management Office, and the Agriculture Knowledge Centre. Where applicable, partnerships with NGOs, cooperatives, and academic institutions will be leveraged to supplement technical expertise, innovation, and outreach capacity.

A central Project Management Unit (PMU), supported by provincial and local-level coordination units, will be responsible for project oversight, financial management, procurement, capacity building, and reporting.

4.3.5. Monitoring, Evaluation, and Learning

Monitoring and evaluation (M&E) are critical elements of the MaWRiN Project to ensure transparency, track progress, and support adaptive management in the implementation of integrated climate-resilient watershed interventions across the Marin Watershed. A participatory M&E framework will be adopted throughout the project period to assess the effectiveness, sustainability, and impact of field activities across the six prioritized catchments.

Participatory monitoring will involve a wide range of stakeholders including representatives from Community Forest User Groups (CFUGs), Leasehold Forest Groups (LFGs), Water User Groups (WUGs), farmers groups, mothers' groups, local governments, and relevant technical line agencies. These entities will play an active role in field-level data collection, review meetings, and validation of progress reports to ensure that the monitoring process remains inclusive, transparent, and grounded in local realities.

Monitoring indicators will cover both biophysical and socio-economic dimensions. Key indicators will include forest cover change, species diversity, soil erosion rates, sedimentation levels, water flow patterns, availability of irrigation water, crop productivity, incidence of forest fires, frequency of floods and landslides, and the participation of vulnerable groups including women and Indigenous Peoples. In addition to environmental outcomes, institutional indicators such as capacity development, governance improvements, and access to extension services will also be monitored.

An annual monitoring report will be prepared within two months following the end of each fiscal year. This report will document physical achievements, expenditures, implementation challenges, and the overall condition of the watershed. The annual reports will serve as a key input for learning, accountability, and strategic course correction.

Mid-term and final evaluations will also be conducted to assess progress against outcome-level indicators. The mid-term evaluation, to be conducted midway through project implementation, will provide feedback on operational performance, highlight best practices, and identify areas requiring improvement. The final evaluation, to be conducted during the last year of the project, will focus on measuring outcomes such as changes in vegetation cover, reduction in disaster risk, effectiveness of community-based adaptation interventions, agricultural productivity improvements, and community engagement.

Overall responsibility for coordinating monitoring activities will lie with the Project Management Unit (PMU) based at the Soil and Watershed Management Office (SWMO) in Ramechhap, with technical inputs from relevant line agencies and local partners. The Monitoring, Evaluation, and Learning (MEL) officer within the PMU will ensure that the system remains functional, data-driven, and aligned with project goals and reporting requirements to the GEF Agency.

4.5 Execution Strategies

Execution strategies have been formulated considering the findings of field assessment, opportunities and challenges in the watershed and objectives of the project.

Spatial prioritization of activities: Activities should be concentrated more in upstream areas, especially at the initial phase of the project implementation. Effective and concerted implementation of soil and water conservation activities such as gully control check dams, water sources protection, plantation etc. in the upstream areas will have positive effects in the downstream areas as well.

Proper balancing of ‘hardware/software’ activities: As expected, local people’s demands and priorities are more focused on physical infrastructure activities like river/stream embankment, irrigation system, and checkdams, and less on other conservation activities, capacity strengthening activities. A proper balance should be reached between ‘hardware’ and ‘software’ activities so that each component will complement another resulting in synergy.

Intensity of program implementation should be more or less balanced across all the sub-watersheds. The more vulnerable areas (both in terms of social and bio-physical features) could have more activities, but generally, the intensity of activities should be proportionate to vulnerable areas, and population across the sub-watersheds.

Consideration of differential impact of climate change: Impact of climate change will differentially affect the people along the axis of gender, ethnicity, age, proximity to vulnerable areas etc. Women, elderly, vulnerable groups such as Majhi, Haayu, Danuwar; people living closer to landslide, flood prone areas are impacted more. Thus, the vulnerable people and areas should be prioritized accordingly during implementation.

Incentivizing conservation activities through physical infrastructure activities: Communities can be encouraged to initiate conservation activities for the physical infrastructure activities supported by the project. For example, many community forests have in practice open grazing system affecting the forest health and controlling open grazing could be set as a precondition/encouragement to launch activities like embankment or irrigation activities.

Focusing on activities with multiplier effects: Activities having multiple benefits should be prioritized. For example, goat farming following stall feeding and forage cultivation will not only

help raise the household income but also improves the condition of health and general crop production. Similarly, construction of contour trenches, conservation ponds will have far reaching implications.

Promotion of entrepreneurship: Implementation should emphasize on promoting entrepreneurship at the community level. For example, support for agriculture activities (like input materials) should be done through/ by promoting local enterprises rather distributing those materials to individual households. The adoption of business model would help in efficient utilization of resources and also in sustainability of the project.

Promotion of demonstration/model sites: One or two sites in each sub watersheds should be promoted as demonstration/model sites where nature-based solutions are implemented in integrated manner to enhance the resilience of communities and ecosystems.

Leveraging of resources from Local governments and other relevant agencies: Encouraging local governments' participation in project cycle and contribution of resources in the common activities (for example irrigation activities, income generating activities). This will add to the ownership of the project and also enhance the sustainability of the project. Coordination should be also encouraged with other relevant institutions such as DFO, President Chure Tarai Madhesh Conservation Board, Agriculture Knowledge Center, Veterinary Hospital and Livestock Expert Service Center in implementation of the activities. Effective networking would enhance the effectiveness and sustainability of the project.

Consideration of scale of operation for different activities: Some activities like forest fire management/control are effective when implemented at large swath across several forests, sub-watersheds. Such activities should be coordinated with multiple forest groups under the aegis of Division Forest Office. While other activities are more effective at smaller scale.

Effective monitoring: Monitoring of progress should provide options for course correction and adaptive management, especially in refining, refocusing of activities in annual plans, implementing policies to capture the context specific issues. Representatives of local governments (including ward chairpersons) could also be made a part of monitoring visit as it would enhance ownership of the local governments and could also generate the resources.

Should the Project plan allow, two monitoring stations should be established for regularly monitor the water discharge and quality (such as turbidity) so as to assess the change in water discharge and water quality as an objective indicator of improvement in soil and water conservation during the project period.

Institutional strengthening of the Sub-watershed Coordination Committee: The committee's managerial capacity should be strengthened. They could be promoted as river basin organizations.

Their role should be streamlined in project implementation. For example, they should be actively involved in annual planning, prioritization of activities, implementation, and monitoring. They should be networked with the other relevant government organizations and local government. The strong institutional basis for championing watershed issues will make the implementation smooth.

Establishing and strengthening of watershed champions: Promoting a few **promising youths, both male and female** (2 to 3 from each sub-watershed) as watershed champion for advocating the watershed issues will help in raising the awareness and also advocating conservation issues with local governments and other relevant organizations. They should be capacitated and supported to undertake various watershed conservation related activities.

Formulate and implement a well-defined communication strategy to reach out to different groups of stakeholders (Palika governments, technical offices, community organizations, vulnerable groups). Effective communication and extension materials should be developed targeting different groups of stakeholders. A positive message will create a conducive environment for effective implementation and contributing to sustainability of the project.

Nepal's federal structure mandates a multi-level governance system for the management of natural resources and climate change. The implementation of the MaWRiN Project in the Marin Watershed requires coordinated action across federal, provincial, and local governments, technical agencies, and community-based organizations. This section outlines the institutional arrangements, stakeholder responsibilities, and governance mechanisms for effective delivery of the project.

5. Conclusion

The participatory assessment conducted under the MaWRiN project has provided a comprehensive and context-sensitive foundation for implementing integrated, climate-resilient interventions across the Marin Watershed. Through a multi-method approach combining literature review, GIS mapping, key informant interviews, focus group discussions, and extensive field observations, the study successfully identified six highly vulnerable sub-watersheds: Ghagar, Kyan, Phulbari, Dhungajor, Jalkeni Sakhauri, and Simale. These sub-watersheds were selected based on biophysical fragility, socio-economic vulnerability, and exposure to climate-induced hazards such as landslides, floods, droughts, and forest fires.

The findings confirm that the Marin Watershed is characterized by degraded ecosystems, limited access to climate-resilient infrastructure, and high dependency on subsistence agriculture and forest resources, particularly among Indigenous and marginalized communities. Climate hazards are further exacerbated by weak institutional coordination, inadequate governance mechanisms, and insufficient technical capacity at the local level.

In response, the report outlines a suite of integrated adaptation activities rooted in nature-based solutions (NbS) and guided by participatory processes. These interventions encompass climate-resilient agriculture, water resource management, livestock improvement, forest restoration, slope stabilization, and inclusive capacity-building. The implementation strategy is designed to ensure coherence across multiple governance levels, leverage community-based institutions as key delivery partners, and embed activities within existing local government planning and budgeting cycles.

Contracts will be established between the project and the six Sub-Watershed Coordination Committees to ensure transparent and accountable implementation. These committees will serve as the central coordination mechanism at the field level, aligning the efforts of user groups, technical institutions, and local governments. Additionally, monitoring and evaluation will be systematically conducted through a dedicated framework led by the PMU, supported by specialized M&E staff, and involving both internal tracking and independent mid-term and terminal evaluations.

This strategic and inclusive framework provides a scalable model for integrated watershed management that can be replicated in other climate-vulnerable regions of Nepal. It addresses the interconnected challenges of ecological degradation, water insecurity, and livelihood vulnerability while strengthening local institutions and enhancing adaptive capacity.

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Annex 1: Demographic data

a) Population data of Marin watershed 2021 and 2011

Ward	Census 2021						Census 2011						Growth Rate	Change in sex ratio
	Number of households	Population			Average household size	Sex ratio	Number of households	Population			Average household size	Sex ratio		
		Total	Male	Female				Total	Male	Female				
Kamalimai Municipality														
1	1104	4565	2197	2368	4.13	92.78	973	4,804	2,262	2,542	4.94	88.99	-0.51	3.79
2	929	3790	1852	1938	4.08	95.56	848	4415	2074	2341	5.21	88.59	-1.53	6.97
4	2346	8818	4309	4509	3.76	95.56	1444	6170	2973	3197	4.27	92.99	3.57	2.57
5	2102	8292	3931	4361	3.94	90.14	1328	6045	2856	3189	4.55	89.56	3.16	0.58
Ghyanglekh Rural Municipality														
1	444	2060	1013	1047	4.64	96.75	415	2261	1047	1214	5.45	86.24	-0.93	10.51
2	686	2724	1323	1401	3.97	94.43	545	3029	1366	1663	5.56	82.14	-1.06	12.29
3	505	2283	1114	1169	4.52	95.3	445	2346	1102	1244	5.27	88.59	-0.27	6.71
Marin Rural Municipality														
1	531	2800	1351	1449	5.27	93.24	441	2922	1360	1562	6.63	87.07	-0.43	6.17
2	807	4547	2293	2254	5.63	101.73	726	4640	2315	2325	6.39	99.57	-0.20	2.16
3	1005	5134	2556	2578	5.11	99.15	836	4962	2378	2584	5.94	92.03	0.34	7.12
4	946	4374	2110	2264	4.62	93.2	758	4408	2105	2303	5.82	91.40	-0.08	1.80
5	651	2860	1417	1443	4.39	98.2	528	2865	1345	1520	5.43	88.49	-0.02	9.71
6	989	4354	2171	2183	4.4	99.45	800	3923	1914	2009	4.90	95.27	1.04	4.18
7	1115	4739	2286	2453	4.25	93.19	781	4102	1865	2237	5.25	83.37	1.44	9.82
Hariharpurgadhi Rural Municipality														
2	857	3942	1941	2001	4.6	97	663	3666	1789	1877	5.53	95.31	0.73	1.69
4	522	2438	1149	1289	4.67	89.14	412	2432	1151	1281	5.90	89.85	0.02	-0.71
5	600	3197	1527	1670	5.33	91.44	550	3583	1721	1862	6.51	92.43	-1.14	-0.99
6	485	2242	1082	1160	4.62	93.28	492	2839	1346	1493	5.77	90.15	-2.36	3.13

7	676	3100	1480	1620	4.59	91.36	640	3756	1816	1940	5.87	93.61	-1.92	-2.25
8	544	2555	1258	1297	4.7	96.99	485	2769	1320	1449	5.71	91.10	-0.80	5.89
Total	17844	78814	38360	40454	4.42	94.82	14110	75937	36105	39832	5.38	90.64	0.37	4.18

b) Sub-watershed wise Demographic Data

Ward	Census 2021						Census 2011						Growth Rate	change in sex ratio	Sub-watershed
	Number of households	Population			Average household size	Sex ratio	Number of households	Population			Average household size	Sex ratio			
		Total	Male	Female				Total	Male	Female					
Kamalamai Municipality															
1	1104	4565	2197	2368	4.13	92.78	973	4,804	2,262	2,542	4.94	88.99	-0.51	3.79	Dhungajor/Ghagar
4	2346	8818	4309	4509	3.76	95.56	1444	6170	2973	3197	4.27	92.99	3.57	2.57	Dhungajor
5	2102	8292	3931	4361	3.94	90.14	1328	6045	2856	3189	4.55	89.56	3.16	0.58	Dhungajor
Ghyanglekh Rural Municipality															
1	444	2060	1013	1047	4.64	96.75	415	2261	1047	1214	5.45	86.24	-0.93	10.51	Simale
Marin Rural Municipality															
1	531	2800	1351	1449	5.27	93.24	441	2922	1360	1562	6.63	87.07	-0.43	6.17	Jalkeni Sakhauri
2	807	4547	2293	2254	5.63	101.73	726	4640	2315	2325	6.39	99.57	-0.20	2.16	Jalkeni Sakhauri
3	1005	5134	2556	2578	5.11	99.15	836	4962	2378	2584	5.94	92.03	0.34	7.12	Kyan
4	946	4374	2110	2264	4.62	93.2	758	4408	2105	2303	5.82	91.40	-0.08	1.80	Phulbari
5	651	2860	1417	1443	4.39	98.2	528	2865	1345	1520	5.43	88.49	-0.02	9.71	Ghagar/Phulbari
Hariharpurgadhi Rural Municipality															
4	522	2438	1149	1289	4.67	89.14	412	2432	1151	1281	5.90	89.85	0.02	-0.71	Jalkeni Sakhauri
5	600	3197	1527	1670	5.33	91.44	550	3583	1721	1862	6.51	92.43	-1.14	-0.99	Jalkeni Sakhauri
6	485	2242	1082	1160	4.62	93.28	492	2839	1346	1493	5.77	90.15	-2.36	3.13	Kyan
7	676	3100	1480	1620	4.59	91.36	640	3756	1816	1940	5.87	93.61	-1.92	-2.25	Kyan
8	544	2555	1258	1297	4.7	96.99	485	2769	1320	1449	5.71	91.10	-0.80	5.89	Kyan

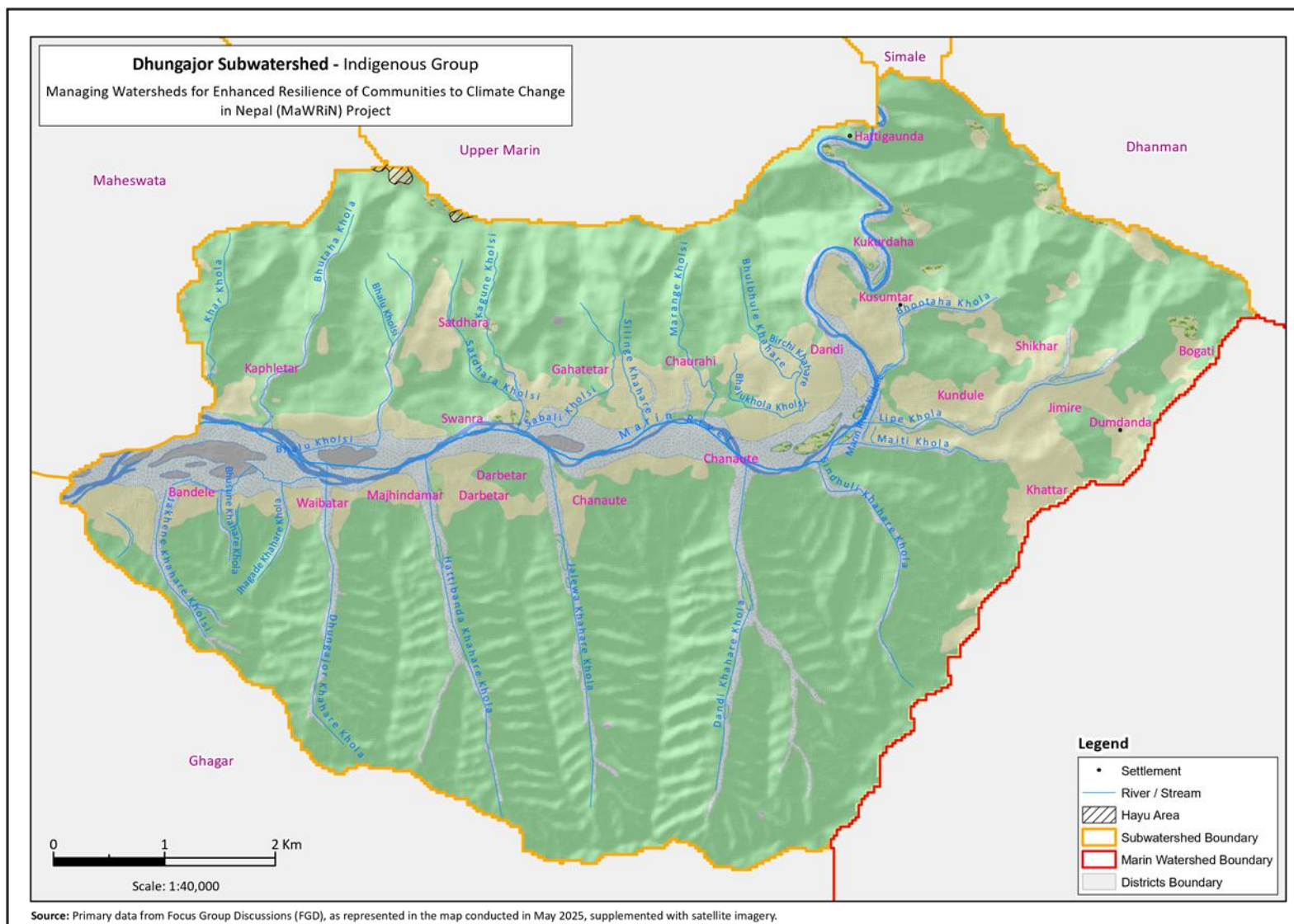
Total	12763	56982	27673	29309	4.46	94.42	10028	54456	25995	28461	5.43	91.34	0.45	3.08
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c) Absentee Population 2021

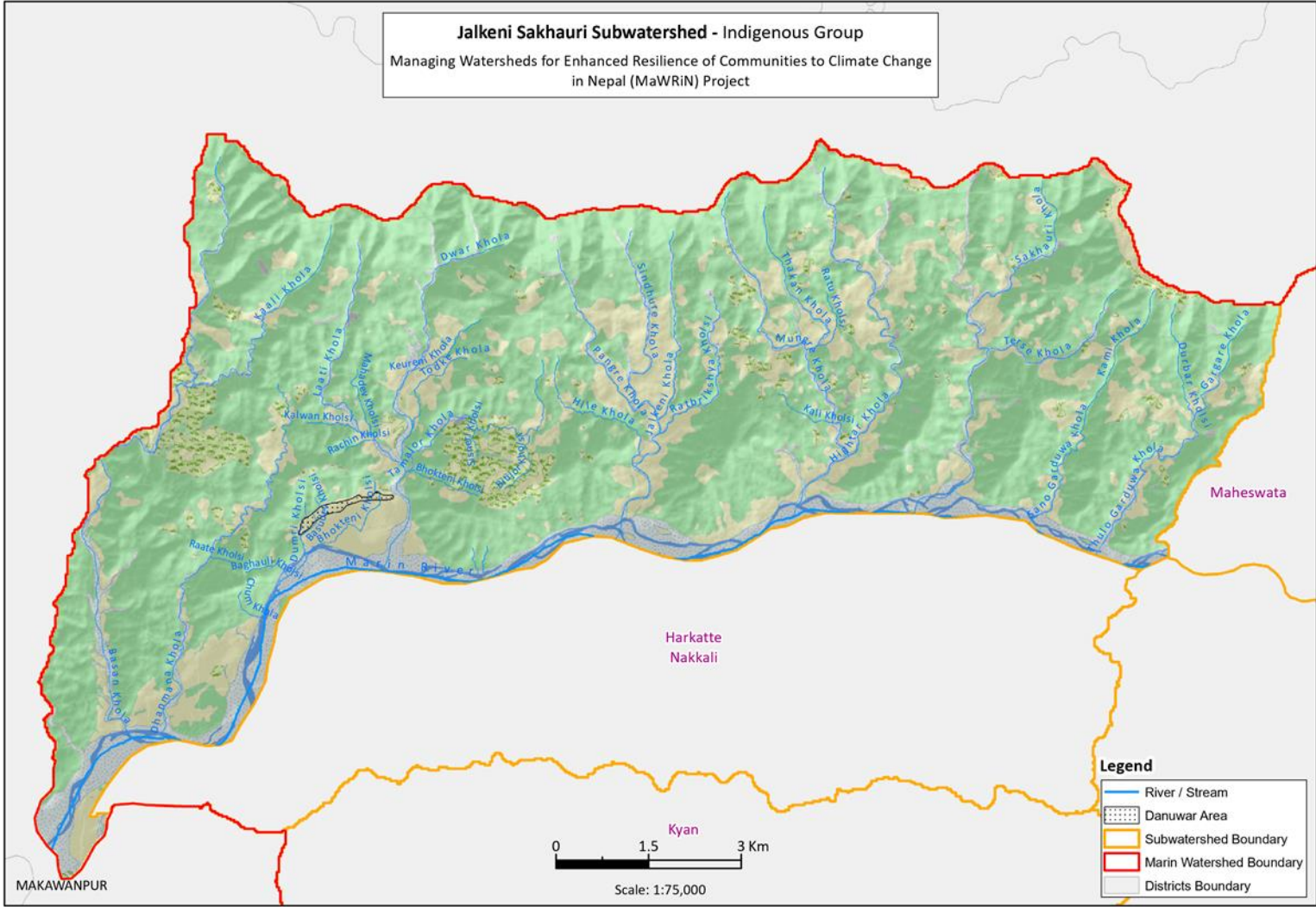
Ward	Usually Absent within county				Usually Absent Abroad				Usually Absent within county %			Usually Absent Abroad %			Total Absentee Population			Total Absentee Population(%)						
	Hou schol d	Population			Hou schol d	Population			Hous ehol d	Population			Hous ehol d	Population			Hous ehol d	Population						
		Total	Male	Fem ale		Total	Male	Fe mal e		Total	Male	Fem ale		Total	Male	Fe mal e		Total	Male	Fem ale				
Kamalamai Municipality																								
1	163	528	292	236	96	118	107	11	29.53	23.13	26.54	19.97	17.48	5.19	9.74	0.97	259	646	399	247	23.46	14.15	18.16	10.43
2	302	844	452	392	181	229	201	28	32.51	22.27	24.41	20.23	19.48	6.04	10.85	1.44	483	1073	653	420	51.99	28.31	35.26	21.67
4	516	1174	685	489	395	476	402	74	21.99	13.31	15.9	10.84	16.84	5.4	9.33	1.64	911	1650	1087	563	38.83	18.71	25.23	12.49
5	415	906	543	363	320	377	313	64	19.74	10.93	13.81	8.32	15.22	4.55	7.96	1.47	735	1283	856	427	34.97	15.47	21.78	9.79
Ghyanglekh Rural Municipality																								
1	72	187	99	88	117	149	129	20	16.22	9.08	9.77	8.4	26.35	7.23	12.73	1.91	189	336	228	108	42.57	16.31	22.51	10.32
2	263	874	461	413	135	178	148	30	38.34	32.09	34.85	29.48	19.68	6.53	11.19	2.14	398	1052	609	443	58.02	38.62	46.03	31.62
3	142	528	308	220	114	143	128	15	28.12	23.13	27.65	18.82	22.57	6.26	11.49	1.28	256	671	436	235	50.69	29.39	39.14	20.10
Marin Rural Municipality																								
1	128	358	200	158	57	65	60	5	24.11	12.79	14.8	10.9	10.73	2.32	4.44	0.35	185	423	260	163	34.84	15.11	19.25	11.25
2	160	499	278	221	147	185	172	13	19.83	10.97	12.12	9.8	18.22	4.07	7.5	0.58	307	684	450	234	38.04	15.04	19.62	10.38
3	302	1104	567	537	216	266	225	41	30.05	21.5	22.18	20.83	21.49	5.18	8.8	1.59	518	1370	792	578	51.54	26.68	30.99	22.42
4	173	455	255	200	192	226	203	23	18.29	10.4	12.09	8.83	20.3	5.17	9.62	1.02	365	681	458	223	38.58	15.57	21.71	9.85
5	109	398	217	181	155	187	163	24	16.74	13.92	15.31	12.54	23.81	6.54	11.5	1.66	264	585	380	205	40.55	20.45	26.82	14.21
6	194	514	269	245	185	222	189	33	19.62	11.81	12.39	11.22	18.71	5.1	8.71	1.51	379	736	458	278	38.32	16.90	21.10	12.73
7	247	681	365	316	216	248	223	25	22.15	14.37	15.97	12.88	19.37	5.23	9.76	1.02	463	929	588	341	41.52	19.60	25.72	13.90
Hariharpurgadhi Rural Municipality																								
2	271	949	521	428	133	163	144	19	31.62	24.07	26.84	21.39	15.52	4.13	7.42	0.95	404	1112	665	447	47.14	28.21	34.26	22.34
4	179	590	336	254	91	120	104	16	34.29	24.2	29.24	19.71	17.43	4.92	9.05	1.24	270	710	440	270	51.72	29.12	38.29	20.95

Ward	Usually Absent within county				Usually Absent Abroad				Usually Absent within county %				Usually Absent Abroad %				Total Absentee Population				Total Absentee Population(%)			
	Hou schol d	Population			Hou schol d	Population			Hous ehol d	Population			Hous ehol d	Population			Hous ehol d	Population			Hou sch old	Population		
		Total	Male	Fem ale		Total	Male	Fe mal e		Total	Male	Fem ale		Total	Ma le	Fe mal e		Total	Male	Fe mal e		Total	Ma le	Fem ale
5	216	856	457	399	140	173	150	23	36	26.78	29.93	23.89	23.33	5.41	9.82	1.38	356	1029	607	422	59.33	32.19	39.75	25.27
6	242	638	334	304	106	138	122	16	49.9	28.46	30.87	26.21	21.86	6.16	11.28	1.38	348	776	456	320	71.75	34.61	42.14	27.59
7	161	524	301	223	111	134	109	25	23.82	16.9	20.34	13.77	16.42	4.32	7.36	1.54	272	658	410	248	40.24	21.23	27.70	15.31
8	188	620	339	281	112	136	113	23	34.56	24.27	26.95	21.67	20.59	5.32	8.98	1.77	300	756	452	304	55.15	29.59	35.93	23.44
Total	4443	13227	7279	5948	3219	3933	3405	528	24.90	16.78	18.98	14.70	18.04	4.99	8.88	1.31	7662	17160	10684	6476	42.94	21.77	27.85	16.01

Annex 2: Indigenous group distribution map

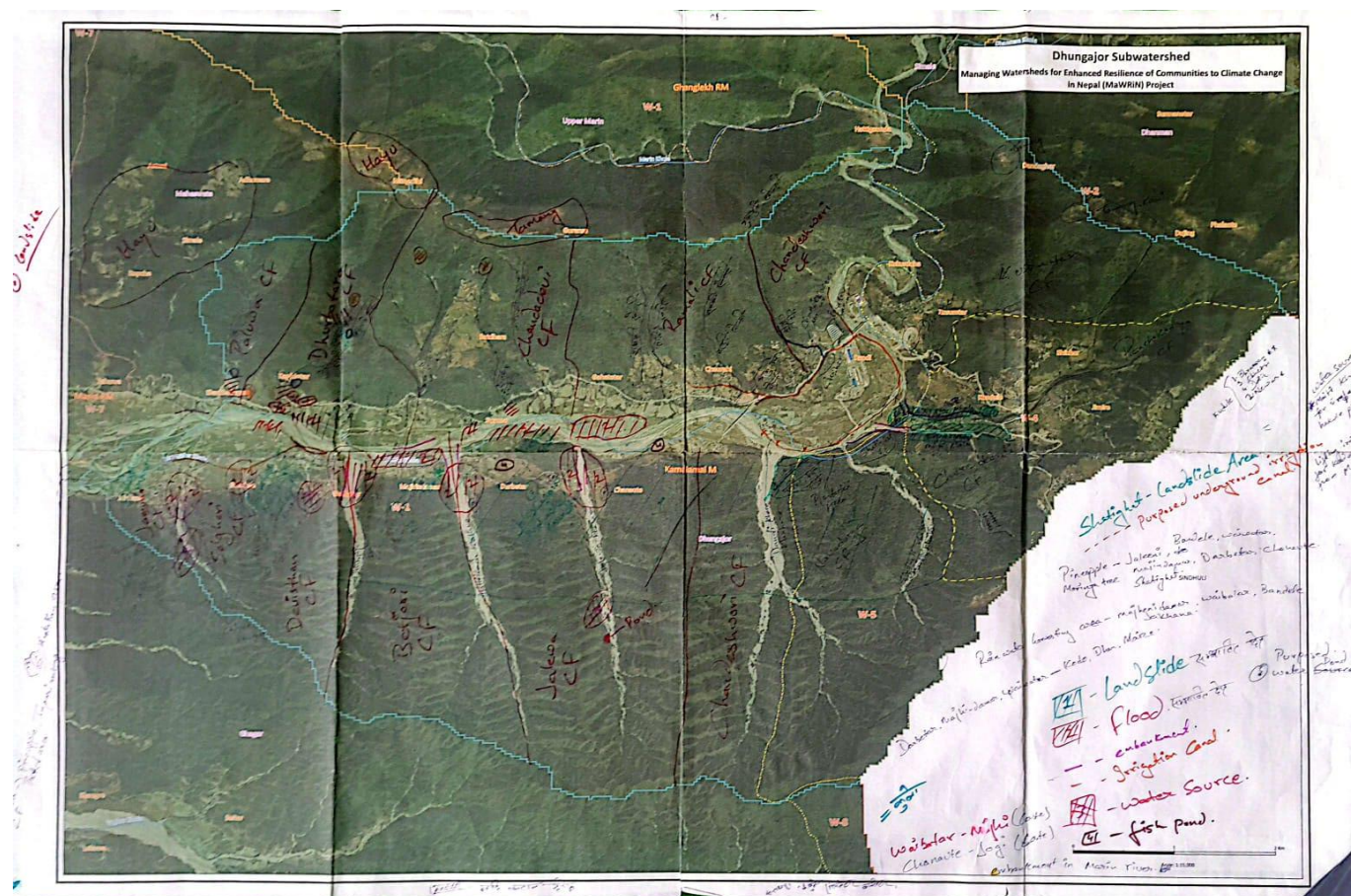


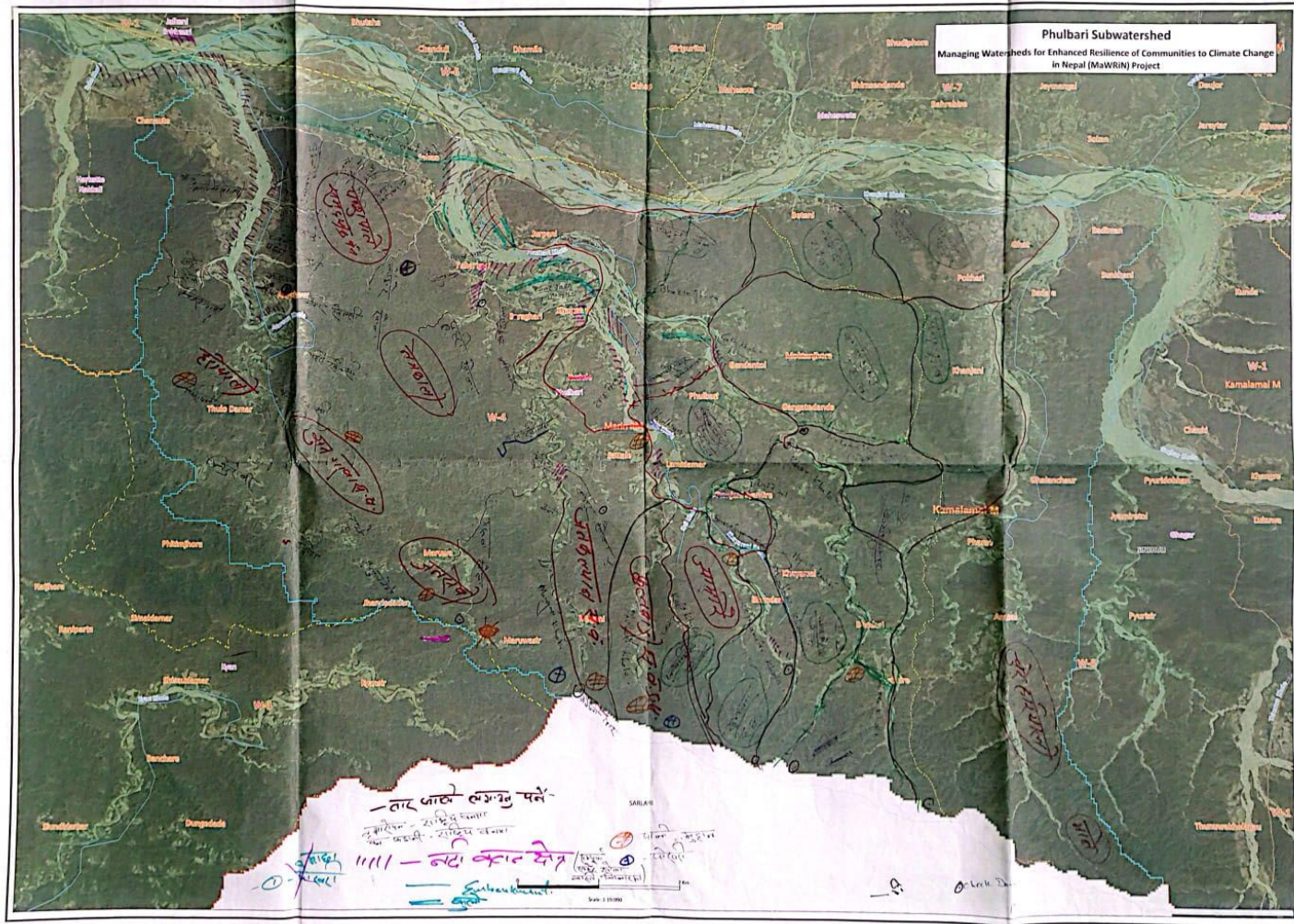
Jalkeni Sakhuri Subwatershed - Indigenous Group
 Managing Watersheds for Enhanced Resilience of Communities to Climate Change
 in Nepal (MaWRIN) Project



Source: Primary data from Focus Group Discussions (FGD), as represented in the map conducted in May 2025, supplemented with satellite imagery.

Annex 3: Participatory Resource Mapping





Annex 4: Checklist of questions for consultation

a) Checklist of questions for district and local Government stakeholders

1) General Information

- Name of respondent
- Designation and department/office
- Administrative level (District / Municipality / Ward)
- Years of experience in the current role
- Contact details

2) Understanding of Local Climate Change Issues

- Key climate-related challenges currently observed in the Marin watershed
- Observed changes in weather patterns, disasters, water sources, agriculture, and biodiversity over the last two decades
- Impacts of climate change on local livelihoods, agriculture, forests, water resources, and health

3) Institutional Roles and Capacities

- Mandates and responsibilities related to climate change, disaster risk reduction (DRR), and environmental conservation
- Ongoing or recent programs/projects related to climate adaptation and resilience
- Existing climate/environmental committees or coordination bodies
- Availability of financial and human resources for climate adaptation
- Access to technical expertise and climate data at the local level

4) Stakeholder Engagement and Governance

- Mechanisms for multi-stakeholder/inter-governmental coordination (district–palika–ward) on climate-related planning
- Approaches to involving communities in climate adaptation planning and implementation including nature-based solutions,
- Inclusion of vulnerable and marginalized groups (women, Dalits, Janajatis, smallholder farmers, etc.) in decision-making
- Use of traditional knowledge or local innovations in planning processes

5) Integrated Adaptation Options

- Priority sectors for adaptation (e.g., agriculture, forestry, water management, infrastructure, nature-based solutions)
- Promoted or potential nature-based solutions (e.g., watershed conservation, agroforestry, eco-restoration)
- Existing sustainable land use, water use, or farming practices
- Examples of traditional or community-based practices that support resilience
- Use and effectiveness of early warning systems or climate information services

6) Implementation Challenges and Opportunities

- Key barriers to implementing adaptation strategies (technical, financial, institutional, social)
- Capacity-building needs among local staff and community stakeholders
- Opportunities for collaboration with civil society, NGOs, private sector, and donor agencies
- Potential for replication or scaling of successful pilot initiatives
- Suggestions to improve climate adaptation mainstreaming in local development plans

7) Monitoring, Learning, and Sustainability

- Existing systems for monitoring adaptation activities and climate risks
- Gaps in data and information needed for decision-making
- Recommendations for ensuring sustainability and local ownership of adaptation interventions

8) Conclusion and Recommendations

- Key recommendations for the assessment team to consider
- Stakeholder's willingness to support or engage in future implementation phases
- Additional comments or insights

b) Checklist for community consultation (sub-watershed level)

1. General

Settlements

Ward number, Name, tentative number of households and ethnicity, migration/immigration

2. Forest

Major forests

Names, CF, area, major vegetation, status of the forest (degraded/ well conserved), wildlife

Forest products harvested status, trend;

NTFPs harvested (fodder, litter, firewood, foods/vegetables, herbs, raw materials, other products), availability, extent of harvest, season of collection

Water sources, springs in the forest

Religious sites (if any) in the forests

Human wildlife conflict

Vulnerable communities to HWC, Major problematic wildlife, types of crops/livestock damaged, seasons/months most affected, property damaged;

Extent of wildlife harmed (retaliatory killing, road accidents)

Mitigation measures

Challenges (forest fires, invasive species, flooding/landslide, grazing, over harvesting etc. and their extent)

3. Grazing land

Major grazing areas, seasons of grazing, livestock types grazed, status of the grazing land (degraded/ good etc.)

Challenges

4. Aquatic ecosystem

Main water sources (streams, ponds, springs), location, water availability trend, seasonality of water availability, quality of water

Drinking water sources, trend of water discharge/availability from drinking water system; irrigation systems (seasonality), settlements facing water shortages (both drinking and irrigation)

Underground water (trend in water table change), quality, pattern of underground water use

Fish species and other aquatic life; trend of diversity, threatened aquatic life

Types of construction materials extracted from streams, location, intensity of extraction and effects

Major challenges

5. Agro ecosystem

Major crops grown in different seasons, Level of external inputs used (fertilizers and pesticides),
Crop seasonality, changes in cropping pattern, incidences of pests
Livestock production (types, average numbers, stall feeding/grazing, trend)
Grass cultivation
Challenges

6. Livelihood

Main livelihood options: subsistence mixed farming pattern, commercial agriculture (vegetable, fruit production, poultry, fishery, bee keeping others); specific economic activities linked to particular ethnic groups/location (if any)
Small scale enterprises in the settlements, auxiliary economic activities
Facilities: market centers, cooperatives, road access, technical services available (animal health worker/agriculture technicians and other technical human resources available)
Trend and magnitude of foreign employment
Potential activities to seize the opportunities, enhance benefits/ improve livelihoods with the use of watershed resources
Potential green economic activities

7. Existing challenges/Threats

Frequency (year) of occurrence, magnitude of damage, most vulnerable areas/communities;
measures adopted for mitigation/recovery of the following hazards

- Landslides
- Floods
- Forest fires
- Storms
- Cold wave/heat wave
- Droughts
- River cutting
- Over extraction of river materials
- Waste Disposal
- Illegal felling/poaching/fishing
- Crop/ livestock pest infestation

8. Governance

CFUGs: number, status (renewal), major issues
LFGs: Number Status major issues
Water User Associations: number, registration, status
Women's groups, youth clubs
Irrigation system management committees
Traditional resource governance organization (if any)
Access to Services of DFO, SWMO, PTCMCDB etc.
Other organizations in resource governance
Resources conflict if any in the past (forest, water sources, grazing areas)
Encroachment
Issues related to upstream downstream linkages

Annex 5: Field Itinerary

SN	Date	Activities	Location
First Phase			
1	22 May	<ul style="list-style-type: none"> • Travel to Sindhuli • Meeting with PMU and presentation of methodology and field plan 	Kathmandu-Sindhuli
2	23 May	<ul style="list-style-type: none"> • Meeting with DFOs in Marin and Sindhuli • Meeting with Agriculture Development Office and Livestock Service Office • FGD at Dhungajor subwatershed in Dravyatar 	Sindhuli, Dravyatar, Kamalmai-1
3	24 May	<ul style="list-style-type: none"> • FGD at Dhungajor subwatershed in Kundule • FGD at Dhungajor subwatershed Bandele 	Kundule, and Bandele Kamalamai-1
4	25 May	<ul style="list-style-type: none"> • FGD at Ghagar Sub-watershed at Nepane • FGD at Ghagar Sub-watershed at Beltar • FGD at Ghagar Sub-watershed at Chaukidanda 	Nepane, Kamlamai-1 Beltar-1, Badripur Chaukidanda, Marin-5
5	26 May	<ul style="list-style-type: none"> • FGD at Phulbari subwatershed at Khayarsal • FGD at Phulbari subwatershed at Jutpani • FGD at Phulbari subwatershed at Sahanchowk 	Khayarsal, Marin-4 Jutpani, Marin-4 Sahan chowk, Marin-4
6	27 May	<ul style="list-style-type: none"> • FGD at Jalkeni Sakhauri Sub-watershed at Dwaar Khola • FGD at Jalkeni Sakhauri Sub-watershed at Mungre Dovan • FGD at Jalkeni Sakhauri Sub-watershed at Tundikhel 	Dwaar Khola, Hariharpurgadhi- 4 Mungre Dovan, Marin-2 Tundikhel, Marin-1
7	28 May	<ul style="list-style-type: none"> • FGD at Kyan Sub-watershed at Barun • FGD Kyan Sub-watershed at Kali Dobhan • FGD Kyan Sub-watershed at Jamunia Parta • FGD Kyan Sub-watershed at Rage Dovan 	Barun, Marin-3 Kali Dovan, Hariharpurgadhi -7 Jamunia Parta, Hariharpurgadhi -8

			Range Dovan, Hariharpurgahdi -6
8	May 29	<ul style="list-style-type: none"> • FGD Dhungajor Sub-watershed at Kafletar • Meeting with NEFIN 	Kafletaar, Kamalamai-1 Sindhuli
9	May 30	<ul style="list-style-type: none"> • FGD Simale Sub-watershed at Simale • Travel back to Kathmandu 	Simale, Ghyaknglekh-1
Second phase			
10	June 21	<ul style="list-style-type: none"> • Travel to Sindhuli • Sharing of draft report at PMU 	PMU office Sindhuli
11	June 22	<ul style="list-style-type: none"> • Consultation meeting at Ghyanglekh RM • Consultation meeting at Kamalamai Municipality • Consultation meeting at Hariharpurgadhi RM 	Ghyanglekh RM meeting hall, Hayutar Kamalamai Municipality Office, Sindhuli Hariharpurgadhi RM Office, Jhanjhane
12	June 23	<ul style="list-style-type: none"> • Consultation meeting at Marian RM 	Marian RM Office, Kapilakot
13	June 24	<ul style="list-style-type: none"> • District level stakeholder consultation meeting at DCC • Travel back to Kathmandu 	DCC meeting hall, Sindhuli

Annex 6: List of the key documents reviewed

- Forests Act, 2076;
- Forest Regulation 2079;
- Forest Policy 2075;
- Forestry Sector Strategy (2015-2025);
- Forest Fire Management Strategy 2067;
- Forest Encroachment Control Strategy 2068;
- Land Use Policy 2072;
- National Climate Change Policy 2019;
- National Adaptation Plan (NAP), 2021;
- National Framework on Local Adaptation Plans for Action (LAPA), 2011;
- National Water Plan, 2005
- National Framework on Local Adaptation Plans for Action (LAPA) the framework 2011
- National River Basin Management Strategies, 2024
- Project document of Managing Watersheds for Enhanced Resilience of Communities to Climate Change in Nepal (MaWRiN)
- Soil and Watershed Conservation Act promulgated in 2039 (1982)
- Soil and Watershed Conservation Regulation in 2042 (1985)
- Local Government Operation Act, 2074
- Vulnerability and Risk Assessment and Identifying Adaptation Options 2021,
- Vulnerability and Risk Assessment and Identifying Adaptation Options in the Forest, Biodiversity and Watershed Management in Nepal 2021
- Wetland Policy 2069

Annex 7: Key Informant Interviews and Focus Group Discussions

S.N.	Key stakeholders	Methods
Government agencies/Project management		
1.	Division Forest Office, Sindhuli	KII
2.	Division Forest Office, Marin	
3.	Project Management Unit	KII
4.	Agriculture Development Office, Sindhuli	KII
5.	Veterinary Service Office, Sindhuli	KII
6	R/Municipality, and Ward Offices, in the project area	KII
7	District Coordination Committee	KII
8	NEFIN	KII
9	Local Knowledgeable people	KII
Community organizations		
	Sub-watershed Coordination Committees	FGD
10.	CFUGs	FGD
11	LFGs	FGD
12	Water User Associations (if any)	FGD
13	Farmers groups	FGD
14	Women's groups	FGD

Annex 8: Information on 488 FGD participants

Description	Disagregated Gender, Economic and Ethnicity	Total	Percent
Gender	Male	303	62.09
	Female	185	37.91
Economic	High class	0	0.00
	Middle class	426	87.30
	Poor condition	62	12.70
Ethnicity	Dalit	32	6.56
	Indigenous	368	75.41
	Brahmin/Chhetri	85	17.42
	Others	3	0.61