

STUDY REPORT

LIVELIHOOD AND CLIMATE RISKS ASSESSMENT OF UP-STREAM, MID-STREAM, AND DOWN-STREAM COMMUNITIES RESIDING IN KATANI AND KANDRA RIVER SUB-WATERSHED



Submitted to:

**Nepal Red Cross Society
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Submitted by:

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Managing Director, IDBS

Abbreviations and Acronyms

ADS	Agriculture Development Strategy
CCA	Climate Change Adaptation
CSA	Climate Smart Agriculture
CDMC	Community Disaster Management Committee
DC	District Chapter
DRR	Disaster Risk Reduction
DRM	Disaster Risks Management
FGD	Focus Group Discussion
GESI	Gender Equality and Social Inclusion
GoN	Government of Nepal
HDI	Human Development Index
HH	Household
IDBS	Innovative Development and Business Solution Nepal
IFRC	International Federation of Red Cross and Red Crescent Societies
INGO	International Non-Governmental Organization
IP	Indigenous people
KII	Key Informant Interview
LDMC	Local Disaster Management Committee
NbS	Nature based Solution
NGO	Non-Governmental Organization
NPR	Nepalese Rupees
NRCS	Nepal Red Cross Society
NRM	Natural Resources Management
PwD	People with disability
RM	Rural Municipality

SC	Sub Chapter
SDG	Sustainable Development Goal
UNDP	United Nations Development Programme
WWF	World Wildlife Fund

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1. Introduction and Background

Nepal, a nation in the Himalayan arc with complex geology and steep terrain, is prone to natural disasters. Geological and hydro-meteorological hazards that disproportionately affect women and girls, people with disabilities, LGBTQI+ people, Dalits, and other marginalized communities include earthquakes, floods, landslides, glacial lake outburst floods (GLOFs), droughts, extreme temperatures, avalanches, and storms (MoHA, 2024). Climate change has made these risks more severe and widespread, which has led to a significant loss of life and property in recent years. In addition to other pressures like the spread of invasive species, climate change-related challenges (such as forest fires, floods, droughts, landslides, soil erosion, etc.) endanger agricultural productivity and biodiversity, endangering remote and rural residents' livelihoods and well-being.

Nepal is among the most climate-vulnerable countries globally due to its complex topography, socio-economic dependencies on natural resources, and high disaster exposure (MoFE, 2019; IPCC, 2022). Climate change in Nepal has manifested through increasing temperatures, erratic rainfall, glacial retreat, and intensified extreme events such as floods, droughts, landslides, and heatwaves (Shrestha et al., 2018; GoN, 2021). These climate shocks disproportionately affect the livelihoods and food security of rural communities, particularly those in the Terai, Chure, and mid-hill regions of the country.

According to the United Nations Development Programme's (UNDP) Human Development Index (HDI) for 2025, Nepal is ranked 145th out of 193 countries, placing it in the medium human development category with notable disparities in human development. Climate risks are primarily caused by Nepal's varied topography, delicate geological structure, delicate ecosystems, and a wide range of climate and microclimate zones, in addition to poverty, illiteracy, and social inequality.

The Kailali District, located in Sudurpashchim Province, exemplifies this vulnerability, encompassing upstream forested slopes, midstream agricultural plains, and downstream flood-prone wetlands. Communities in these landscapes face multiple climate-induced risks affecting agriculture, livestock, forest resources, fisheries, and water security, which form the primary livelihood base (NRCS, 2023).

Despite ongoing Nature based Solution (NbS) interventions, there is limited systematic evidence on climate-induced livelihood risks and the feasibility of integrating climate-smart practices into existing programs. This assessment was therefore focused on to:

- Identify climate-induced risks affecting livelihoods in upstream, midstream, and downstream communities.

- Provide evidence-based recommendations for climate-smart and NbS-aligned livelihood options.
- Support NRCS and partners in designing sustainable, inclusive, and resilient community interventions.

1.1. Literature Review

Climate Change Impacts on Livelihoods

Previous studies indicate that climate variability is a major driver of agricultural and livelihood risks in Nepal. Shrestha et al. (2018) note that Terai communities face crop yield reductions of 10–30% under current climate variability, with monsoon flooding and drought being the primary stressors. Similarly, Paudel et al. (2020) highlight that households relying on small-scale subsistence agriculture are more exposed to climate-induced shocks, often leading to income losses, food insecurity, and migration.

Nature-Based Solutions and Ecosystem-Based Adaptation

Cohen-Shacham et al. (2016) emphasize that NbS contribute not only to climate adaptation but also to biodiversity conservation and livelihood diversification. In the Nepalese context, Khatri et al. (2021) report that wetland and forest restoration projects have led to increased fish production, fodder availability, and eco-tourism opportunities, improving household income and resilience to climate hazards. NbS interventions are also aligned with the UNFCCC adaptation strategies and the Nepal Climate Change Policy (2019), providing a pathway for community-led ecosystem management (MoFE, 2019).

Nature-Based Solutions and Livelihood Resilience

Nature-based Solutions (NbS) are defined as “actions to protect, sustainably manage, and restore natural or modified ecosystems to address societal challenges effectively and adaptively, providing human well-being and biodiversity benefits” (IUCN, 2020). NbS approaches have been increasingly recognized as integrated strategies that link ecosystem restoration with climate adaptation, disaster risk reduction, and livelihood enhancement (Cohen-Shacham et al., 2016).

Within Nepal, NbS programs are applied in various contexts including wetland restoration, community forestry, floodplain management, and agroforestry interventions. Evidence suggests that NbS can enhance adaptive capacity, reduce vulnerability to floods and droughts, and provide sustainable income opportunities (Khatri et al., 2021; WWF & IFRC, 2022).

The NRCS, in partnership with IFRC and WWF, has been implementing an NbS program in Kailali District to strengthen community resilience through ecosystem-based

approaches across five local governments covering six wards along upstream, midstream, and downstream zones. While initial interventions focus on ecological restoration, there is a critical need to assess climate-induced livelihood risks to integrate climate-smart strategies within ongoing programs (NRCS, 2023).

Socioeconomic Vulnerability and GESI Considerations

Livelihood resilience is influenced by gender, social inclusion, and equity factors. UNDP (2020) indicates that women, Dalits, and marginalized groups often have less access to land, credit, and technical knowledge, making them more vulnerable to climate-induced shocks. Studies by ICIMOD (2021) highlight that participatory approaches and inclusive planning significantly enhance the effectiveness of climate adaptation and NbS interventions.

Livelihood Vulnerability and Climate Risks

Livelihood vulnerability in Kailali is shaped by high dependence on agriculture and forest resources, limited access to irrigation and climate-resilient inputs, and exposure to floods, droughts, landslides, and heat stress (Shrestha et al., 2018; GoN, 2021). The upstream zones are prone to landslides, forest degradation, and water scarcity; midstream zones face erratic rainfall and moderate floods affecting crop production; downstream zones are highly susceptible to riverine floods and prolonged inundation impacting crops, livestock, and settlements (MoFE, 2019; NRCS, 2023).

Vulnerable groups, including women-headed households, Dalits, Janajati minorities, landless households, and the elderly, are disproportionately affected due to limited access to resources, decision-making, and social protection mechanisms (UNDP, 2020; ICIMOD, 2021).

1.2. Project and Assignment Background

The Nepal Red Cross Society (NRCS) with IFRC and WWF support, has been implementing the Nature-based Solutions (NbS) Program in Kailali to strengthen community resilience through ecosystem-based approaches in five local government's communities of the district covering six wards of up-stream (ward no.5 of Mohanyal Rural Municipality), mid-stream (ward no. 4 & 9 of Ghodhaghodi Municipality and ward no.7 of Gauriganga Municipality), and down-stream (ward no.4 of Bhajani Municipality, ward no. 5 of Kailari Rural Municipality) of Katani and Kandra river sub-watershed.

While NbS interventions are underway, there is a recognized need to:

- Identify climate-induced risks affecting livelihoods;
- Integrate climate-smart approaches within ongoing programs; and

- Generate practical recommendations to ensure sustainability and community ownership.

The assessment is therefore serve as the foundation for designing and mainstreaming climate-smart livelihood strategies that address the seven societal challenges of the NbS framework including food security, disaster risk reduction, water security, and human well-being under the guiding theme “*Working with Nature to Protect People*”.

Hence, to fulfil the targeted objectives, this assignment was commissioned by the Innovative Development and Business Solution Nepal Pvt. Ltd. (IDBS), Hattiban, Lalitpur for assessing the livelihood and climate risks of up-stream, mid-stream and down-stream communities of six wards of aforementioned local governments of Kailali district, Nepal.

1.3. Objective

The objectives of the assessment were to:

- I. Identify climate-induced risks associated with existing and potential livelihoods in target communities.
- II. Recommend practical, context-specific, and inclusive climate-smart livelihood options for enhancing local community resilience through integration of climate-smart practices into livelihood planning and program design.
- III. Provide evidence-based recommendations to inform NRCS and partners’ future interventions under NbS and climate adaptation frameworks.

1.4. Organization of the report

Altogether, there are five sections in this report. The first section is about general introduction of the study, and presents on the general background of the project and the objective of the study. The second section presents the study approach and methodology of this survey respectively. The third section includes the findings and their discussion related to general socio-demographic features of the local communities, livelihood and economic conditions of the targeted households. Finally, the fourth section comprises conclusion and recommendations from this study.

1.5. Study location

The assignment was undertaken in project location of six wards of five local government falls under Katani and Kandra river sub-watershed of Mohana river watershed in Kailali district, Sudurpaschim Province, Nepal as mentioned below.

Table 1. Study location

District	Local Government	Ward/Community	Landscape Position
Kailali	Mohanyal Rural Municipality	5	Upstream
Kailali	Gauriganga Municipality	7	Midstream
Kailali	Ghodaghodi Municipality	4 & 9	Midstream
Kailali	Bhajani Municipality	4	Downstream
Kailali	Kailari Rural Municipality	5	Downstream

The map showing Kailali district and targeted rural/municipalities in the figure below.

Figure 1: Location Map of the Kailali District

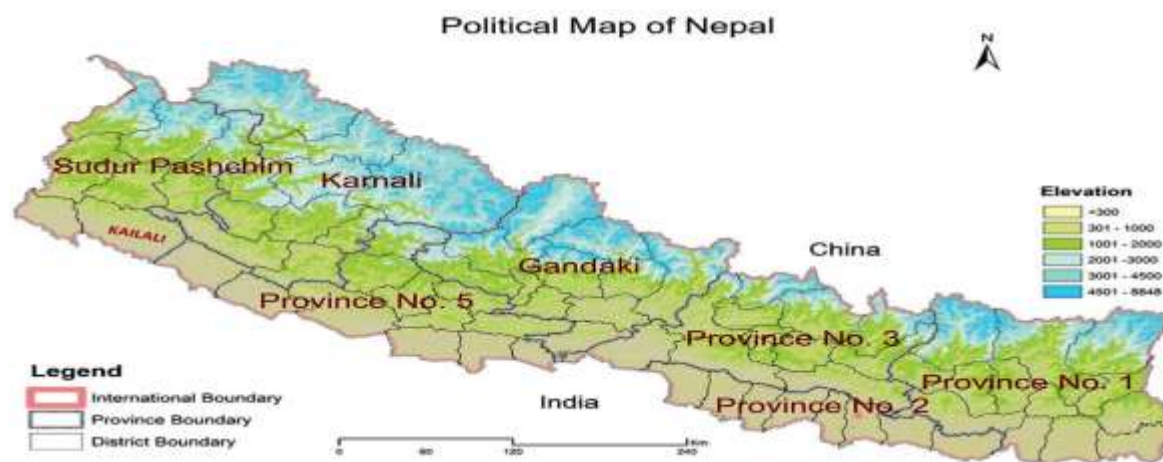


Figure 2: Location Map of the Kailali District with targeted Rural/Municipality Covered Under the Study



Figure 3: Map showing locations of Katani and Kandra river sub- watershed of Mohana river watershed, Kailali district, Nepal

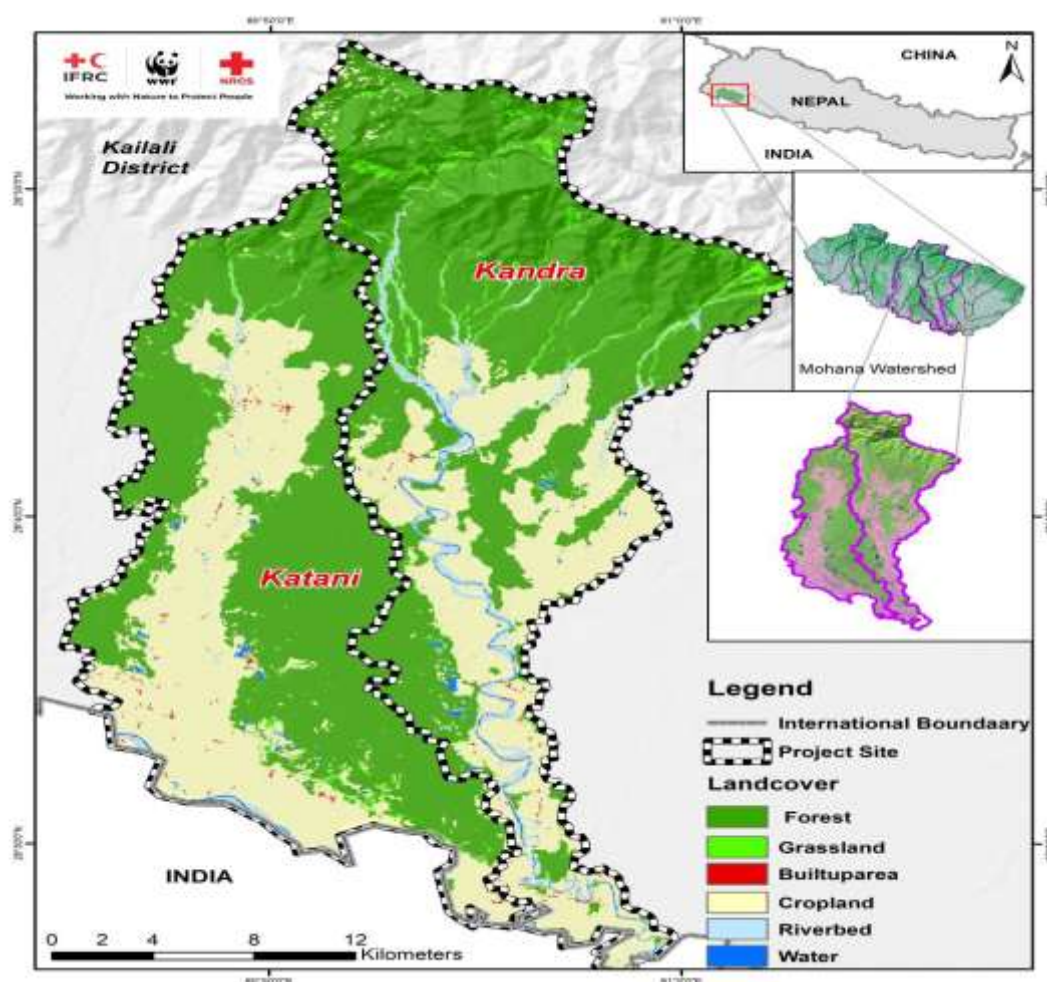


Table 2. Local government-wise area of Katani and Kandra river sub-watershed

S.N.	Name of R/Municipality	Katani Sub-Watershed area (ha.)	Kandra Sub-Watershed area (ha.)
1	Bhajani	1,939	6081
2	Kailari	17,863	978
3	Gauriganga	11,457	1,809
4	Ghodaghodi	2,143	26,800
5	Mohanyal	2,723	7,779
	Total	36,125	43,447

2. Study Approach and Methodology

2.1 Study Approach

The overall approach of the study was participatory and consultative and both the primary and secondary sources of information were used. The assessment followed the participatory and evidence-based mixed-method approach, combining desk reviews, field assessments, and consultations at community and institutional levels. The approach was concentrated in assessing the actual livelihood and climate risks of the targeted beneficiaries at up-stream, mid-stream and down-stream communities of six wards of five local governments of Kailali district, Nepal. The study approach was sensitive about any negative and biased perception throughout the study and consider do no harm approach.

The approach emphasizes:

- Do-No-Harm principles for ensuring ethical engagement and neutrality
- Watershed Perspective: Assessing upstream, midstream, and downstream interactions and interdependencies.
- NbS Integration: Identifying opportunities for ecosystem-based interventions that generate co-benefits for nature and communities.
- Community empowerment by integrating local coping practices into risk mitigation planning
- GESI-responsive participation, prioritizing voices of women, marginalized groups, and local knowledge holders

The approach ensured that findings reflect *lived experiences*, *local priorities*, and *practical solutions* suitable to each hydrological zone.

2.2 Study Methodology

The data and information were collected from both primary and secondary sources. The method of data and information collection included direct observation and transect walk, key informants interview (KII), and focus group discussions (FGDs), in the selected communities of Kailali district as mentioned above.

A. Phase 1: Desk Review and Preparation

- Reviewed relevant docs of NRCS, IFRC, WWF, and government documents, including NbS, DRM, and climate change policies.

- Developed assessment tools (checklists for FGD and KII), and field plan.
- Coordination with NbS Program team of NRCS/IFRC for finalizing methodology.

B. Phase 2: Inception and Consultation

- Inception meetings with NRCS HQ and District Chapter team, IFRC, and WWF.
- Sharing and finalization of methodology and data collection plan.
- Orientation of enumerators, local volunteers, and field coordinators.

C. Phase 3: Field Assessment

- Conducted field visits to six wards of five municipalities.
- Following tools were used for data collection:
 - **Key Informant Interviews (KIIs)** with community leaders, community forest user committee representatives, and local government representatives and relevant officials related to forest, environment, climate change, disaster risk reduction, agriculture and livestock. 26 KIIs conducted with the relevant informants throughout the study area.



Figure 3. Photograph of KII with Vice-Chairperson of Janata CFUGC, Ghodhaghodi municipality-9

The KII were undertaken at every level of informants such as Provincial Ministry Focal Persons (MoITFE & MoIAL), Division and Sub-Division Forest Offices, community leaders, relevant expert/official of civil societies and development partners, and Ward Chairperson/Representatives of the

selected wards including Mayor of the targeted Rural/Municipalities based on the checklists.



Figure 4. Photograph of KII with Lead Farmer, CDMC Chair, and Guage Reader of Kailari RM-5

Key informants in a community are important informers for situation assessment of a particular area.



Figure 5. Photograph of KII with chairperson of ward 4 of Bhajani Municipality

The study team identified knowledgeable persons among the residents of selected Wards of targeted Rural/Municipalities.



Figure 6. Photograph of KII with Mayor of Ghodaghodi Municipality

- **Focus Group Discussions (FGDs)** with smallholder farmers, women farmers, youth, People with Disability (PwD), Dalit, indigenous groups, traditional knowledge holders, and landless and wage-labour households.



Figure 7. Focus group discussion with vulnerable upstream communities

Six FGDs one in each targeted wards helped assess impacts of climate change on livelihood, identify the potential of farming, potential food crops

and cash crops, opportunity and gaps in livelihood practice, needs of the communities for livelihood improvement and capacity of the communities.



Figure 8. Focus group discussion with vulnerable midstream communities

FGDs were organized in all selected wards of up-stream, mid-stream, and down-stream of Kateni and Kandra river sub-watershed.



Figure 9. Focus group discussion with vulnerable downstream communities

- **Observation and Transect Walks** to assess livelihood practices and exposure to climatic hazards in all the targeted wards of five local governments.



Figure 10. Observation and transect walk with knowledgeable member of local communities

The information were also collected from relevant sources such as rural/municipality level profile and other published and unpublished reports and documents.

D. Phase 4: Data Analysis and Synthesis

- Qualitative data analysis was carried out by using descriptive and thematic methods.
- Identified of livelihood risk zones and priority sectors.
- Prepared assessment findings and recommendations.

E. Phase 5: Validation and Reporting

- Sharing of draft findings to NbS project team for feedback.
- Consultation workshop was organized in Dhangadhi to validate the study findings and recommendations from all stakeholders.
- Incorporation of feedback and preparation of final report was done.
- Submission of final deliverables.

3. Findings and discussions

I. Community Context and Livelihood Situation

A. Up-stream Areas of Kateni and Kandra River Sub-watershed (Mohanyal RM, Ward No. 5)

i. General Community Background

Mohanyal Rural Municipality Ward No. 5 is located in the Terai Bhabar to upper Siwalik transitional zone of Kailali District, functioning as one of the crucial upstream catchments feeding the Kateni and Kandra rivulets, which converge downstream into the larger Mohana River system. The settlement pattern is scattered, with clusters located on ridge tops, gentle slopes, and river terraces, reflecting both the geomorphic constraints and traditional settlement practices of hill communities.

The ward is primarily inhabited by indigenous Janajati groups (mainly Magar) and some Dalit communities, along with small populations of Chhetri households. The socio-economic profile shows a mixed subsistence economy, characterized by agriculture-livestock integration, seasonal labor migration, and forest-resource dependency. Literacy levels are improving among youth, especially girls, but adult literacy remains moderate. Access to basic services such as health, education, and market centers is constrained by distance, rugged terrain, and limited road connectivity, especially during the monsoon.

Households maintain diverse livelihood strategies to reduce risk, yet the area remains highly vulnerable to climate-induced shocks (landslides, erratic rainfall, drought spells, crop disease) and structural vulnerabilities such as limited landholdings and poor irrigation infrastructure. Livelihood roles are differentiated:

- Women take the lead in agriculture, household care, fodder collection, and water management.
- Men participate more in seasonal migration, timber harvesting, and off-farm wage labor.
- Youth increasingly migrate for foreign employment or engage in short-term contract labor.
- Marginalized and land-poor households engage heavily in wage labor, forest product collection, and small livestock rearing.

ii. Major Livelihood Activities

Agriculture and Farming

Major Food Crops

Agriculture is predominantly rainfed, relying on monsoon rainfall with limited supplementary irrigation from springs and small rivulets. The key food crops reported during FGD include:

- Maize – primary staple grown on upland bari land.
- Millet – often intercropped with maize in sloping terrains.
- Paddy – grown in limited lowland khet pockets where water is available.
- Wheat and barley – cultivated during winter where moisture is sufficient.
- Seasonal vegetables – potatoes, cauliflower, beans, gourds; primarily for household consumption but occasionally sold in local markets.

Major Cash Crops

Although cash cropping remains modest due to land and market constraints, households increasingly cultivate:

- Lentil and other pulses
- Mustard and sesame
- Off-season vegetables such as tomatoes and leafy greens
- Fruits including citrus, banana, and guava, responding to market demand
- Spices such as turmeric and ginger in small plots, with potential for expansion

Livestock

Livestock Types and Importance

Livestock is an essential part of the mixed farming system. Households typically raise:

- Goats – primary income source; high demand but affected by disease outbreaks
- Cattle/oxen – very few for ploughing and milk
- Buffalo – for dairy and manure, though fewer due to fodder scarcity
- Poultry – small numbers for household consumption and supplementary income

Livestock sales particularly goats serve as a financial buffer during emergencies, festivals, and major expenses (schooling, medical needs).

Fodder Availability and Veterinary Access

Fodder collection relies heavily on community forests, private forests, and open grazing lands, but availability in dry months is low. Key challenges include:

- Seasonal fodder shortages, especially during winter
- Livestock diseases, including PPR, FMD, and parasitic infections
- Limited veterinary services, requiring long travel or waiting for periodic mobile camps

Non-Farm Livelihood Options

The community's non-farm livelihoods supplement household income significantly:

- Wage labor (local) – agriculture labor, construction, stone/wood extraction
- Seasonal migration – to Dhangadhi, Ghodaghodi, or other Terai towns for farm and factory labor
- Foreign employment – mainly among youth (Mostly India, few Gulf countries)
- NTFP collection – broom grass (amriso), bamboo, wild fruits, medicinal herbs
- Forest-based work – timber and non-timber forestry operations under CFUGs
- Small enterprises – homestays (emerging), small shops, tailoring, local transport services

iii. Opportunities and Barriers for Different Social Groups

Women:

- Strong role in agriculture and livestock, but limited access to land ownership and financial services
- Time poverty due to household workload
- Limited mobility restricts participation in market and training events

Youth:

- High aspiration for migration and formal employment

- Lack of local job opportunities and skills training
- Limited engagement in traditional agriculture

Marginalized/Dalit households:

- Depend heavily on wage labor
- Smaller landholdings or landlessness reduces livelihood security
- Higher exposure to climate shocks due to settlement locations

Land-poor households:

- Rely on livestock (goats, poultry) and forest resources
- Vulnerable to food insecurity during climate extremes

B. Midstream Areas of Kateni and Kandra River's Sub-watershed (Gauriganga Municipality– 7 & Ghodaghodi Municipality– 4 & 9)

The midstream section of the Kateni and Kandra river sub-watershed including Ward No. 7 of Gauriganga Municipality and Wards No. 4 and 9 of Ghodaghodi Municipality represents a socio-ecologically diverse landscape characterized by mixed farming systems, significant forest–wetland interactions, and a blend of traditional and semi-commercial livelihoods. These communities lie between the steep upstream slopes of Mohanyal and the floodplain downstream areas of Kailari and Bhajani, making them a critical ecological transition zone. Their proximity to the Ghodaghodi Lake Complex, river corridors, community forests, and agricultural belts shapes both the livelihood base and climate vulnerability profile of local households.

i. General Community Background

Communities in these midstream wards are generally multi-ethnic mostly Tharu, including Dalit, Janajati, Chhetri, and migrant hill-origin groups. The Tharu community represents a substantial proportion, particularly in Ghodaghodi, reflecting longstanding cultural ties to wetlands, forest resources, and traditional farming. Population density is moderate to high, with most settlements clustered near agricultural lands, forest edges, and accessible roads.

Households are mostly dependent on agriculture and natural-resource-based activities. Landholding patterns vary widely:

- Some households possess medium-sized plots for rice and wheat cultivation,

- While many marginalized and Dalit households either have very small landholdings or work as sharecroppers or wage laborers.

Access to services such as schools, health posts, cooperatives, and marketplaces is better than in upstream areas, though still limited for poor households living farther from road corridors. Gender norms remain conservative, but women's participation in savings groups, community agriculture, and cooperatives has been gradually increasing.

The presence of active community forest user groups (CFUGs), agriculture groups, wetland management committees, and cooperatives contributes to social cohesion. Local governments maintain frequent engagement with communities through ward offices, but gaps remain in extension services, water management, and climate adaptation support. Social capital is relatively strong, with labor-sharing practices such as *parma* used extensively during peak agricultural seasons.

ii. Major Livelihood Activities

Agriculture as the dominant livelihood

Agriculture remains the backbone of the midstream economy. The fertile plains support rice–wheat–maize rotations, along with increasing cultivation of seasonal and off-season vegetables such as tomato, cauliflower, chili, pumpkin, and cucumber. Households with access to irrigation (canal, tube wells, or groundwater) are more likely to diversify into vegetables for market sale.

However, agriculture remains heavily climate-dependent. Erratic rainfall, waterlogging, and prolonged dry spells often affect crop yields, making midstream farmers vulnerable to climate-induced shocks.

Livestock rearing

Livestock plays a crucial role in household food security and income. Common livestock include:

- Goats, increasingly seen as a profitable household asset
- Few Cows and mostly buffalo for milk production
- Oxen few for plowing by poorer households
- Pigs and poultry primarily among marginalized groups

Livestock contributes significantly to women's livelihoods, as they manage feeding, fodder collection, cleaning, and milk processing.

Fishing and wetland-related occupations

Communities located near the Ghodaghodi wetlands, river canals, and small ponds engage in small-scale fishing, aquatic plant harvesting, and seasonal collection of snails (ghonghi)—particularly among Tharu and marginalized groups. These activities provide nutritional supplements and occasional income, but are increasingly affected by wetland degradation, sedimentation, and declining water quality.

Forest and NTFP-based livelihoods

Forest products such as firewood, fodder, leaf litter, mushrooms, medicinal herbs, and bamboo are essential for household needs. Women depend heavily on community forests for fuel and livestock fodder. Some households engage in NTFP collection (such as kurilo, pipla, broom grass), though commercialization remains limited due to poor market linkages and lack of value addition.

Wage labor and short-term employment

Wage labor has become an important income source for poorer households, particularly during the agricultural off-season. Men often engage in:

- Agricultural wage labor (ploughing, planting, harvesting)
- Construction work
- Road or irrigation maintenance jobs
- Sand/gravel extraction near river areas (in some pockets)

Women generally engage in agricultural labor, grass-cutting, and household-based earning activities.

Seasonal migration and foreign employment

A significant proportion of youth and working-age men migrate for seasonal work, particularly to:

- India (Punjab, Uttar Pradesh, Uttarakhand, Himanchal Pradesh) for farm and factory work
- Gulf countries for long-term remittance employment

Remittances serve as an important buffer against climate-related income shocks. However, migration often increases workloads for women and elderly family members left behind.

iii. Livelihood Differences among Women, Men, Youth, and Marginalized Groups

Gender-based livelihood roles

Women and men contribute differently to household livelihoods:

- Women undertake most work related to livestock care, kitchen gardening, fodder collection, crop weeding, post-harvest processing, and participation in savings groups. They also manage household water and fuel needs.
- Men generally engage in land preparation, ploughing, irrigation canal maintenance, external wage labor, seasonal migration, and market transactions.
- Decision-making (sale of livestock, crop selection, investment, land leasing) remains mostly dominated by men, although women's voices are increasing in households engaged in cooperatives.

Youth involvement

Youth face limited local employment opportunities and often prefer migration due to:

- Lack of profitable agricultural opportunities
- Inadequate access to skills, tools, and credit
- Lower interest in traditional farming

However, some youth groups expressed interest in commercial vegetables, beekeeping, fish farming, poultry, and digital/market-based enterprises, if supported.

Marginalized and Dalit groups

Marginalized communities (Dalit, landless, female-headed households) face multiple livelihood constraints:

- Limited or no land ownership
- Reliance on wage labor or sharecropping
- Lower access to irrigation and credit
- Vulnerability to climate hazards (heat stress, water scarcity, floods)
- Exclusion from decision-making forums

Their livelihoods are highly climate-sensitive and require targeted support to reduce vulnerability.

C. Downstream Areas of Kateni and Kandra River's Sub-Watershed (Bhajani Municipality– 4 & Kailari Rural Municipality– 5)

The downstream communities of Bhajani Municipality- 4 and Kailari Rural Municipality- 5 lie within the lower floodplains of the Kateni and Kandra sub-watersheds, directly influenced by the hydrological dynamics of the Mohana River. These areas are highly productive yet extremely fragile due to recurring floods, waterlogging, riverbank erosion, and sedimentation. The socio-economic profile shows a blend of agriculture-dependent households, marginalized groups with limited land ownership, and communities reliant on wage labor and seasonal migration.

i. General Community Background

The downstream communities are characterized by:

- High dependence on agriculture and natural resources, with most households engaged in smallholder farming.
- Mixed caste and ethnic composition, significantly Tharu, Dalit, and other groups, each with distinct livelihood constraints and opportunities.
- Higher population density compared to upstream areas, with settlements concentrated near market centers, roadside corridors, and agricultural fields.
- Land fragmentation and tenancy, where many marginalized households cultivate small plots or operate under informal sharecropping agreements.
- Limited livelihood diversification, especially among poor and landless groups, making them more vulnerable to climate shocks.
- Youth outmigration, particularly to India and the Gulf countries, contributing to remittance inflows but also weakening agricultural labor availability.

Basic services such as schools, health posts, and cooperative services are present but vary in quality and accessibility. Transport access is relatively better due to proximity to the Hulaki Highway and the East-West Highway, yet flood damage often disrupts mobility.

ii. Major Livelihood Activities

Agriculture

Agriculture is the primary livelihood source:

- Main crops: paddy, wheat, maize, mustard, pulses, and vegetables (tomato, cauliflower, okra, leafy greens).
- Cropping pattern: dominated by paddy (2 rotation)–wheat rotations, with increasing interest in riverbed farming and off-season vegetable cultivation where irrigation is available.
- Challenges: frequent monsoon floods, prolonged waterlogging, dry-season water scarcity, pest outbreaks, declining soil fertility.

Livestock Rearing

Livestock contributes significantly to household nutrition and income:

- Common livestock: buffalo, goats, poultry, cattle,
- Downstream areas face challenges such as fodder scarcity, increased livestock disease incidence after floods, and limited veterinary services.

Fishing and Wetland-Based Livelihoods

Communities living near the Mohana river and its tributaries engage in:

- Seasonal and subsistence fishing.
- Harvesting of wetland resources such as snails, wild vegetables, and thatch grasses.

These activities are particularly important for Dalit and marginalized groups, who depend more heavily on common natural resources.

Wage Labor

Wage labor is a critical livelihood option due to:

- Limited land ownership.
- Climate-induced crop losses.
- Availability of daily wage opportunities in nearby markets, construction, agriculture labor, and brick kilns.

NTFPs and Forest-Based Livelihoods

Access to forest resources is lower compared to upstream communities, but some households engage in:

- Fuelwood collection.
- Grass and fodder harvesting.
- Limited NTFP collection (e.g., medicinal herbs, broom grass). Tharu communities retain some traditional forest-use knowledge, though pressure on natural resources is increasing.

Seasonal Migration and Foreign Employment

Due to recurring climate shocks and limited income sources:

- Short-term migration to India is common among men, especially during dry seasons.
- Foreign employment (Gulf countries, Malaysia) is a growing strategy for households seeking stable income.
- Remittances are used mainly for household consumption, debt repayment, and children's education.

iii. Differences in Livelihood Activities by Gender and Social Groups

Women

- Engage heavily in agriculture labor, seedling preparation, weeding, post-harvest processing, and kitchen gardening.
- Manage small livestock (goats, poultry, pigs).
- Participate in local markets for vegetable and small livestock sales.
- Face constraints due to limited land ownership, restricted mobility, and high household workload.

Men

- Focus on land preparation, irrigation, cash crop cultivation, and livestock grazing.
- Access more opportunities in wage labor and migration, contributing to household cash income.
- Participate more in market transactions and decision-making related to farming.

Youth

- Involved in agriculture seasonally but increasingly prefer wage labor or migration.
- Some youth groups engage in motorbike freight services, agrovets, or small trade businesses.
- Limited interest in traditional farming due to poor profit margins and high climate risks.

Marginalized Groups (Dalit, landless, indigenous Tharu communities)

- Depend more on:
 - wage labor
 - fishing and river-based resources
 - seasonal migration
- Have lower access to land, credit, and extension services, resulting in higher vulnerability.
- Women from marginalized households face multiple layers of exclusion, including limited access to training, leadership roles, and markets.

II. Climate and Environmental Risks**A. Upstream Areas of Kateni and Kandra River's Sub-watershed (Mohanyal RM, Ward No. 5)****i. Local Climate Trends****Temperature Changes**

Participants in the FGD consistently reported a noticeable rise in temperature over the last 10–15 years. Summer months are perceived to be hotter and longer, while winter seasons have become shorter and comparatively warmer. Farmers highlighted that traditional cold-tolerant crops (e.g., barley, some winter vegetables) now face stress due to insufficient winter chill. Livestock herders also noted increased heat stress symptoms in goats and cattle during peak summer, particularly in low-lying river terrace areas.

Rainfall Variability and Patterns

Rainfall has become significantly erratic, with unpredictable onset of the monsoon and uneven distribution throughout the season. The community highlighted:

- Delayed monsoon arrival, often shifting by 2–4 weeks
- Intense short-duration rainfall events, increasing surface runoff
- Reduced winter rainfall, weakening soil moisture and affecting winter crops
- Increasing dry spells during the crop-growing season

This variability directly disrupts the traditional agricultural calendar and increases the risk of crop failure.

Frequency of Extreme Events

According to community accounts:

- Drought: Increasingly frequent, especially during pre-monsoon and winter months. Springs and small rivulets in the upper watershed dry earlier than before.
- Floods and Flash Floods: The upper catchments of Kateni and Kandra experience rapid runoff during intense monsoon rains, triggering small but destructive flash floods in local streams.
- Riverbank Cutting: Reported particularly along lower river sections, affecting terrace fields and foot trails.
- Landslides: Minor to medium-scale landslides occur frequently on steep slopes during heavy rainfall, damaging trails, farm plots, and water supply systems.
- Hailstorms: Increasingly irregular but more destructive, often damaging maize, millet, and vegetable crops.
- Heatwaves: Households reported more frequent hot days (>35°C equivalent), affecting livestock and reducing work capacity, especially for women and elderly people.
- Pest Outbreaks: The spread of fall armyworm in maize and increasing fungal diseases in vegetables were strongly linked to warmer and wetter conditions.

Perceived Causes of Changes

Most participants associated climate changes with:

- Deforestation and forest degradation in upstream slope areas

- Global climate change, learned through radio, schools, NGOs, and community discussions
- Local land-use change, such as road construction and poorly managed slopes
- Decline in water sources, linked to prolonged drought and rainfall inconsistency

ii. Climate-Induced Impacts on Livelihoods

FGD findings reveal broad and interconnected impacts across livelihood domains.

Agriculture and Crop Production

- Maize, millet, and paddy yields have declined due to irregular rainfall, prolonged dry spells, pest outbreaks, and nutrient loss caused by erosion.
- Intense rainfall events lead to crop wash-off, especially in sloped bari land.
- Winter crops suffer moisture stress, reducing wheat, mustard, and lentil productivity.
- Hailstorms damage vegetables, causing complete loss at times.

These impacts have increased the cost of cultivation (inputs, replanting, pest control) and decreased overall income from farming.

Livestock Health and Production

- Heat stress has reduced milk productivity in cows and buffaloes.
- Fodder scarcity during winter and prolonged dry periods has weakened goats and cattle, leading to reduced weight gain.
- Disease incidence has risen, including PPR in goats and FMD in cattle, which farmers believe is influenced by warmer temperatures and poor sanitation during the monsoon.
- Flash floods occasionally damage grazing routes, forcing longer herding times.

Women, who primarily manage livestock feeding and care, face an increased workload collecting fodder from distant forests.

Forest Resources and NTFPs

Community members reported several climate-related impacts on forests:

- Drying of key fodder species and reduced regeneration of natural grasses

- Decline in NTFPs, such as broom grass and medicinal plants, due to shifting rainfall patterns
- Soil erosion on steep forest slopes, making collection trails more hazardous
- Forest fires during dry months, increasingly common and threatening both forest health and community safety

These pressures directly affect land-poor and marginalized households who depend heavily on forest resources.

Water Sources and Availability

- Springs and small streams feeding the Kateni and Kandra rivers are reportedly drying earlier in the year.
- Community taps and traditional irrigation systems face reduced flow, affecting domestic water availability and winter vegetable cultivation.
- Sediment load in streams increases during intense rainfall, damaging intake systems and pipes.

Women and girls—responsible for water collection—are disproportionately affected by the need to travel longer distances.

Social and Economic Impacts

Climate impacts have increased:

- Household expenses (food purchases, livestock treatment, seeds, fertilizers)
- Seasonal migration, particularly among youth
- Food insecurity, especially during drought years

Land-poor households were identified as most food insecure, as they have limited crop production buffer and rely heavily on daily wage labor, which is disrupted by extreme weather.

Groups Most Affected

According to community perspectives:

- Women: Increased burden in water, fodder, firewood collection
- Poor and landless households: Less capacity to recover from crop/livestock losses

- Dalit and marginalized groups: High exposure to climate shocks, limited resources
- Persons with disabilities and elderly: Greater difficulty responding to hazards
- Children: Nutritional stress when crop yields decline

iii. Disaster Events and Community Preparedness

Major Climatic Hazards (Ranked by Community)

1. Irregular and erratic rainfall
2. Drought and water scarcity
3. Landslides and slope failures
4. Flash floods in local streams
5. Hailstorms and crop-damaging winds
6. Forest fires
7. Pest and disease outbreaks

Risk-Prone Zones within the Ward

FGD participants identified the following high- exposure zones:

- Steep slopes above settlement clusters – prone to landslides
- Riverbank areas of Kateni and Kandra – vulnerable to erosion and flooding
- Foot trails and community forests – affected by landslides and fire
- Drying spring zones in upper catchments – water insecurity hotspot

Traditional Early Warning and Coping Practices

Communities rely on a combination of local knowledge and emerging external information:

- Observing cloud movement, wind direction, bird behavior, and insect activity to predict rainfall
- Mobilizing community labor to clear drainage channels before monsoon
- Storing grains and fodder during anticipated drought periods
- Temporary migration of livestock to safer grazing areas

- Social networks for food borrowing and labor sharing during crises

However, these informal systems are increasingly insufficient as climate variability intensifies.

Existing Disaster Risk Management Structures

Several structures exist but operate with varying levels of functionality:

- Community Disaster Management Committees (CDMCs)- present but require capacity strengthening
- Local Disaster Management Committees (LDMCs)- linked with the Rural Municipality
- Irrigation user groups- play a key role in maintaining small canals and water-sharing norms
- Forest user groups (CFUGs)- actively support fire control, slope stabilization, and watershed conservation
- Cooperatives- provide small loans for emergency needs, though coverage is limited for marginalized households

While the institutional base exists, communities emphasized the need for technical support, early warning systems, mitigation infrastructure, and better coordination among groups.

B. Midstream Areas of Kateni and Kandra River's Sub-watershed (Gauriganga Municipality– 7 & Ghodaghodi Municipality– 4 & 9)

The midstream communities of Gauriganga Ward 7 and Ghodaghodi Wards 4 and 9 lie in the transitional zone between the upland Chure foothills and the downstream Terai plains. The proximity to the Kateni and Kandra river systems, coupled with the influence of the Ghodaghodi Lake Complex and adjacent forest areas, creates a unique ecological and hydrological setting that exposes communities to multiple climate and environmental risks. Findings from FGDs, KIIs, and transect observations reveal that climate variability has become increasingly unpredictable, intensifying livelihood vulnerabilities for agriculture-dependent, low-income, and socially marginalized households.

i. Local Climate Trends

Changes in Temperature

Participants from all three wards consistently reported a notable rise in average temperatures, particularly:

- Hotter summers with extended heat periods beginning earlier (late March) and lasting longer (until mid-September).
- More frequent heat waves, with midday temperatures described as “unbearable” for fieldwork.
- Rising nighttime temperatures, reducing soil moisture retention and increasing irrigation demand.

Changes in Rainfall Patterns

Communities observed major shifts in rainfall behavior over the last 10–15 years:

- Delayed onset of monsoon, disrupting planting calendars for paddy, maize, and vegetables.
- Short, intense rainfall bursts causing flash floods and rapid river swelling.
- Erratic rainfall distribution, with long dry spells between rain events.
- Increased post-monsoon rainfall damaging standing winter crops (wheat, lentils, mustard).

Increasing Frequency of Climate Hazards

FGD participants identified the following trends:

- Floods and riverbank cutting: Kateni and Kandra rivers increasingly overflow, eroding farmland near river corridors (notably in Ghodaghodi-4’s Lalbojhi and Gauriganga-7’s Beligoti area).
- Waterlogging: Low-lying agricultural lands, especially in Ghodaghodi-9, remain inundated for days after rainfall.
- Droughts: Winter drought has become common, reducing the yield of winter crops.
- Hailstorms: More frequent during pre-monsoon, damaging maize, vegetables, and fruit seedlings.

- Pests and diseases: Outbreaks of fall armyworm in maize, rice blast, vegetable wilting, and livestock vector-borne diseases have increased.
- Forest degradation and invasive species: Climber infestation (maile lahara) and invasive plants (*Mikania micrantha*) spreading across community forests reduce fodder availability and biodiversity.

Community Perception of Causes

Participants attributed climate changes to:

- Deforestation and degradation of Chure foothills.
- River system instability and sediment loads.
- Loss of wetlands and natural vegetation.
- “Global warming” and atmospheric pollution.
- Soil fertility decline due to chemical fertilizer overuse and erosion.

ii. Climate-Induced Impacts on Livelihoods

Climate variability directly affects farming, livestock, fishing, forest-based livelihoods, and household economy. Impacts vary across socio-economic and gender groups.

Impact on Agriculture

- Paddy: Irregular monsoon reduces transplanting success; floods cause crop lodging; droughts delay tillering.
- Maize: Highly affected by fall armyworm; dry spells reduce cob formation; hailstorms damage early crops.
- Vegetables: Heat stress, water scarcity, and pests reduce productivity; waterlogging destroys leafy vegetables.
- Oilseeds and legumes: Seasonal unpredictability leads to poor germination and lower yields.
- Fruit farming: Increasing heat and pests affect mango and banana quality; storms often topple young fruit trees.

Overall impact

Reduced productivity, increased input costs, and greater crop failure risks.

Impact on Livestock

- Declining fodder availability due to drying of grazing areas near forests.
- Increased livestock diseases (skin diseases, tick infections, foot-and-mouth outbreaks).
- Heat stress reduces milk production among cows and buffaloes.
- Water scarcity impacts livestock drinking water sources.

Impacts on Forest and NTFP-Based Livelihoods

- Scarcity of fodder, fuelwood, and leaf litter due to invasive species.
- NTFP availability (kurilo, amriso, mushroom, medicinal herbs) decreases with rising temperature and forest degradation.
- Conflicts between humans and wildlife increase (monkey crop raids).

Impacts on Water Resources

- Springs and shallow wells drying earlier.
- Waterlogging near wetlands affects settlements and agricultural lands.
- Siltation in irrigation canals makes water supply unreliable.

Food Security Implications

- Poor households experience seasonal food deficits for 2–4 months.
- Increased dependence on wage labor, borrowing, and subsidized cooperative loans.
- Rising food prices worsen the situation for landless and Dalit households.

Differential Impacts on Social Groups**Most Affected Groups**

- Women: Increased workload in water collection, fodder management, and coping activities.
- Poor and landless households: Limited assets to recover from shocks; high dependence on wage labor.

- Dalit and indigenous communities: Higher vulnerability due to location in hazard-prone zones and limited access to resources.
- Persons with disabilities (PWDs): Limited mobility during floods and emergency situations; exclusion from early-warning networks.
- Youth: Migration increases due to shrinking livelihood opportunities.

iii. Disaster Events and Community Preparedness

Major Climatic Hazards (Ranked by the Community)

Rankings from FGDs (combined for all three wards):

1. Floods and riverbank erosion
2. Drought and long dry spells
3. Waterlogging
4. Heat waves
5. Hailstorms
6. Pests and crop diseases
7. Storms/windstorms

Risk-Prone Zones

- Agricultural fields adjacent to Kateni and Kandra rivers is under high erosion and flood exposure.
- Low-lying settlements in Ghodaghodi-9 severe waterlogging.
- Areas near forest edges, wildlife intrusion and invasive species spread.
- Poorly drained farmland around household clusters- crop damage due to wet conditions.

Community Preparedness and Coping Mechanisms

Traditional and emerging practices include:

- Elevated grain storage (makai bhakari) to protect against flooding.
- Staggered cropping calendars to reduce full-season loss risk.
- Mutual labor exchange (parma) during emergencies.
- Crop diversification (vegetables, banana, millet) as coping strategies.

- Temporary migration for wage labor to India and urban centers.
- Early warnings through mobile phones and neighbor networks (informal).

Existing Disaster Risk Management (DRM) Structures

- Community Disaster Management Committees (CDMCs): Active but under-resourced; limited training and equipment.
- Local Disaster Management Committees (LDMCs): Present at LG level but not fully engaged with ward-level action.
- Farmer groups, cooperatives, and irrigation user groups: Play roles in water management and collective action, though capacities vary widely.
- Forest user groups: Contribute to watershed protection but face challenges of encroachment and funding.

Gaps and Needs Identified

- Lack of reliable early warning systems and structured communication pathways.
- Limited technical knowledge on climate-smart agriculture (CSA).
- Insufficient irrigation and drainage infrastructure.
- Need for hazard mapping and localized DRM plans.

C. Downstream Areas of Kateni and Kandra River's Sub-Watershed (Bhajani Municipality– 4 & Kailari Rural Municipality– 5)

Downstream areas of the Kateni and Kandra sub-watersheds particularly Bhajani Municipality Ward 4 and Kailari Rural Municipality Ward 5 face chronic and recurring climate and environmental risks due to their flat lowland geography, high flood exposure, and dependence on agriculture. These communities represent the last receiving point of upstream flow, sediment, and floodwater, making them extremely vulnerable to hydrometeorological hazards and slow-onset climatic stresses.

i. Local Climate Trends

Rising Temperatures and Heat Stress

FGD participants consistently reported noticeable increases in summer temperatures, prolonged heat waves, and early onset of hot conditions over the past 8–10 years. Farmers observed that:

- Field work in peak summer months (April–June) has become physically harder.
- Heat stress is increasingly affecting livestock, particularly cattle and goats.
- Vegetables such as tomato, cucumber, and leafy greens suffer from wilting and reduced fruit-setting during heat waves.

Changes in Rainfall Patterns

Rainfall has become erratic, concentrated, and high-intensity, disrupting agricultural cycles:

- Monsoon now arrives later than in the past, followed by sudden spells of torrential rainfall.
- Long dry spells occur even within monsoon months.
- Winter rainfall (critical for wheat, mustard, and lentil) has significantly decreased.

Farmers noted the shift from a predictable monsoon pattern to a volatile one, complicating decisions on sowing, transplanting, and harvesting.

Drought Frequency and Soil Moisture Loss

Downstream areas historically benefitted from fertile floodplain soils, but communities report:

- More frequent pre-monsoon droughts, leading to early crop stress.
- Drying of shallow tube wells and hand pumps in April–May.
- Reduced soil moisture retention due to sedimentation, sand deposition, and loss of vegetative cover upstream.

Floods, Inundation, and Riverbank Cutting

Flooding is the dominant hazard in Bhajani- 4 and Kailari- 5:

- Flash floods from Kateni and Kandra tributaries combine with Mohana River overflow.

- Even moderate rainfall upstream creates downstream flooding within hours.
- Prolonged waterlogging persists for weeks to months in agricultural land.
- Riverbank cutting increasingly threatens settlement areas and agricultural fields.

Participants stated that unpredictable flood timing has made monsoon cropping extremely risky.

Waterlogging and Drainage Issues

Flood-prone lowlands experience:

- Waterlogging in paddy fields that destroys seedlings and stunts crop growth.
- Damage to roads, culverts, and irrigation canals due to prolonged inundation.
- Reduced land productivity over time due to silt deposition and soil compaction.

Dry Spells and Seasonal Water Scarcity

Despite being flood-prone, downstream communities experience seasonal water stress:

- Dry spells during the pre-monsoon reduce fodder availability.
- Hand pumps show reduced discharge.
- Livestock face drinking-water shortages.

Hailstorms, Pest Outbreaks, and Crop Diseases

Local farmers observed:

- More frequent hailstorms during winter and early monsoon.
- Increase in pests such as fall armyworm (FAW), stem borer, rice bugs, aphids.
- Increased incidence of livestock parasites due to warmer temperatures.

Perceived Causes of These Changes

Community perceptions identify:

- Climate change and shifting monsoon patterns.
- Deforestation and upstream land-use change, leading to faster runoff.
- Poor drainage and natural river course shifts.
- Sedimentation and embankment breaches creating new flood pathways.

ii. Climate-Induced Impacts on Livelihoods

Impacts on Crops and Agriculture

Heavy flooding, erratic rainfall, and heat stress have significantly affected crop productivity:

- Paddy crops often get submerged during transplanting, leading to replanting costs.
- Vegetables are extremely vulnerable to both heat waves and flood damage.
- Wheat and mustard suffer from lack of winter rainfall and increased temperature.
- Sand deposition reduces the productivity of agricultural lands near riverbanks.
- Loss of agricultural inputs (seed, fertilizer) stored at home during flood events.

Farmers reported production losses of 30–70% in years with severe flooding.

Effects on Livestock

Climate events affect livestock in multiple ways:

- Heat waves reduce milk production.
- Flooding forces temporary displacement of livestock to higher land.
- Increased spread of livestock diseases (FMD, PPR, parasitic infections).
- Shortage of fodder due to prolonged inundation of grazing areas.

Impacts on Fisheries and Aquatic Resources

Floodwater brings:

- Loss of fish from local ponds due to overflow.
- Contamination of water bodies.
- Reduced fish catch in rivers due to siltation.

Effects on Forest Resources

Although downstream communities rely less on forests compared to upstream, climate events:

- Reduce availability of grasses, firewood, and NTFPs.
- Increase dependence on market for fodder and fuel during long inundations.

Most Affected Groups

FGDs revealed that climate impacts are not uniform:

- Poor and landless households lose crops and wage labor income.
- Women bear increased burden of water collection, livestock care, and household recovery work.
- Dalit and marginalized communities living in low-lying areas face higher exposure to flooding.
- Households with persons with disabilities (PwDs) struggle to evacuate during floods.
- Smallholder farmers experience disproportionate losses due to limited savings and lack of irrigation access.

Increased Household Costs and Income Loss

Climate shocks increase:

- Cost of replanting, seeds, and pest control.
- Health expenses for livestock treatment.
- Borrowing from cooperatives or moneylenders to recover losses.

Many households experience seasonal food shortages lasting 2 to 4 months.

Food Security Impacts

Food security is highly sensitive to climate-driven agricultural losses:

- Lower crop production increases dependence on purchased food.
- Flood-damaged grain storage results in sudden shortages.
- Women report needing to reduce meal frequency during crisis periods.

iii. Disaster Events and Community Preparedness

Major Climatic Hazards (Ranked by Risk)

1. Monsoon Floods and Inundation
2. Riverbank Cutting
3. Waterlogging

4. Heat Waves and Drought
5. Hailstorms and Windstorms
6. Pest and Disease Outbreaks

Risk-Prone Zones

- Settlements and farmland directly along the Mohana River.
- Areas near breached embankments and poorly maintained drainage channels.
- Low-lying paddy fields that remain waterlogged for long periods.
- Sand-deposited floodplain areas with declining soil fertility.

Traditional Early Warning and Coping Practices

Communities rely on:

- Observing upstream river flow and rainfall indicators.
- Communication with relatives in midstream/upstream areas.
- Use of traditional high grounds ("chautari", school grounds) as shelter points.
- Diversification of small crops on raised beds as a flood buffer.

However, early warning systems remain informal and inconsistent.

Existing Disaster Risk Management Structures

Some institutional mechanisms exist but are unevenly functional:

- Community Disaster Management Committees (CDMCs): active in both Bhajani- 4 and Kailari- 5.
- Local Disaster Management Committees (LDMCs): operational at municipal level but limited outreach at settlement level.
- Irrigation groups: engaged in canal cleaning but lack capacity to address flood drainage.
- Cooperatives and savings groups: provide limited emergency credit for recovery.
- Ward offices: coordinate relief but lack pre-disaster preparedness plans.

Overall, downstream communities recognize increasing climate risks but lack adequate institutional support, infrastructure, and early warning systems to cope effectively.

III. Natural Resource Management and Nature-based Solutions (NbS) Context

A. Upstream Areas of Kateni and Kandra River's Sub-watershed (Mohanyal RM, Ward No. 5)

i. Forest and Ecosystem Resources

Dependence on Community Forests and Local Ecosystems

Communities in Ward No. 5 maintain a long-standing and multi-functional dependence on natural ecosystems, particularly community forests, river systems, wetlands, and riparian zones of the Kateni and Kandra rivulets. Forests supply essential resources such as:

- Fuelwood, the primary source of household energy
- Fodder and bedding materials for livestock
- Timber and poles for house construction and farm infrastructure
- Non-timber forest products (NTFPs) including broom grass, bamboo, medicinal herbs, mushrooms, and wild fruits
- Leaf litter and organic matter for composting and soil fertility management

River ecosystems provide:

- Seasonal water for drinking, livestock, and limited irrigation
- Wild fish and aquatic resources, although declining
- Sand, gravel, and stones used for household construction
- Traditional bathing and cultural sites

These resources remain particularly critical for Dalit, land-poor, and women-headed households, who rely more heavily on forest and river ecosystems for daily subsistence.

Changes in Forest Cover, Water Sources, and Biodiversity

FGD participants reported that forest conditions have improved over the last decade due to community forest governance, but climate pressures, increased anthropogenic use, and invasive species continue to challenge ecosystem health. Noted changes include:

- Reduced regeneration of native species due to erratic rainfall and prolonged dry periods.
- Increasing presence of invasive species (e.g., banmara), affecting fodder availability.
- Drying water sources, particularly springs in upper slopes, with reduced flow during pre-monsoon and winter.
- Declining biodiversity, including reduction of small mammals, birds, and traditional medicinal plant species.
- Increased forest fire incidents, attributed to extended dry spells and unmanaged leaf litter.

Although community forest user groups (CFUGs) play a central role in forest protection, they face challenges related to limited financial resources, insufficient monitoring, climate-related stresses, and varying participation from marginalized groups.

Forest-User Group Involvement and Challenges

The ward hosts several active Community Forest User Groups (CFUGs) responsible for forest patrolling, thinning, plantation, and fire control activities. However, challenges include:

- Unequal participation of women, marginalized communities, and youth in decision-making.
- Insufficient technical knowledge for managing climate-related forest issues such as invasive species, forest degradation, and slope stabilization.
- Limited budgets for watershed-scale restoration or large-scale plantation programs.
- Inadequate fire control mechanisms despite growing wildfire risks.
- Dependency on voluntary labor, which is declining due to youth migration.

Overall, community forest institutions remain strong local actors but require capacity-building, technical guidance, and financial support to manage increasing environmental pressure.

ii. Soil, Water, and Land Use Issues

Soil Fertility and Erosion

Soils in the upper watershed are shallow, fragile, and erosion-prone, especially on sloped bari land. Local observations include:

- Declining soil fertility due to nutrient loss, inadequate organic matter, and reduced fallow periods.
- Increased topsoil erosion during intense rainfall events, leading to siltation of lower fields and streams.
- Gully formation and small landslides in degraded slopes, exacerbated by unplanned road construction.
- Reduced soil moisture retention, particularly affecting rainfed maize and millet crops.

The reliance on traditional farming practices and minimal soil conservation measures intensify vulnerability.

Water Sources, Irrigation, and Access

Water availability is a major stress point in Ward No. 5. Key FGD findings include:

- Heavy reliance on springs, streams (Kateni and Kandra), and small ponds for domestic and irrigation use.
- Seasonal drying of water sources, especially from February to June.
- Traditional irrigation canals (kulos) exist but face issues of damage from landslides, siltation, and low water flow.
- Lack of water storage structures for dry season vegetable farming.
- Increasing demand for water due to expansion of livestock and vegetable production.

Water scarcity primarily affects women and girls, who must walk longer distances to collect water during dry months.

Water Scarcity Trends and Coping Strategies

Communities noted clear trends of worsening water scarcity. Coping strategies include:

- Staggered water collection from remaining springs.
- Water-sharing and turn-taking systems during peak scarcity.
- Increased use of plastic storage tanks and rooftop harvesting (where present).
- Relying more on CFUG sources for dry-season fodder and water.
- Temporary migration of livestock to distant grazing areas.

Despite these efforts, existing coping strategies are becoming insufficient against prolonged dry spells.

Land Ownership, Tenancy, and Access to Productive Land

Land ownership patterns in the ward are mixed:

- Many households hold small, fragmented plots with limited irrigation access.
- Dalit and marginalized groups often have small or no land, relying on sharecropping and wage labor.
- Land tenure insecurity reduces incentive to invest in long-term land improvements such as terraces, plantations, or soil conservation.
- Encroachment along riverbanks for cultivation increases erosion risk and heightens exposure to flash floods.

Land distribution inequalities shape the extent to which households can adopt climate-resilient or NbS-based practices.

iii. Awareness and Perceptions of Nature-based Solutions (NbS)

Community Awareness of NbS Activities

Overall awareness of the term “Nature-based Solutions” is limited, but community members are familiar with activities that fall under the NbS umbrella. Through CFUGs, NGOs, and local government programs, they recognize efforts such as:

- Plantation and forest restoration
- Slope stabilization using natural vegetation
- Water source protection
- Community-based fire management
- Agroforestry practices

Participants expressed willingness to learn more about NbS if supported with training and demonstrations.

Existing NbS Practices in the Area

Existing or past NbS-related initiatives identified during the FGD include:

- Riverbank plantation using bamboo and native species to control erosion along Kateni and Kandra streams
- Watershed protection activities by CFUGs, including fencing of water sources and planting fodder trees
- Agroforestry systems integrating fruit trees, fodder species, and crops

- Terrace improvement and plantation of grass for soil stabilization
- Small pond rehabilitation for livestock watering and limited irrigation

While these interventions have brought benefits, they remain small-scale and fragmented across the ward.

Perceived Benefits and Limitations of NbS

Benefits reported:

- Improved soil stability and reduced erosion
- Increased availability of fodder and firewood
- Improved water recharge, especially around protected spring areas
- Reduced riverbank cutting where bamboo and tree plantations are maintained
- Enhanced biodiversity and forest cover
- Lower household workload due to improved resource availability nearby

Limitations noted:

- Slow visible outcomes—community members expect more immediate results
- Lack of consistent technical guidance
- Limited labor availability due to youth outmigration
- Damage to plantations from goat grazing
- Insufficient financial resources and weak institutional support
- Fragmented efforts that do not address watershed-level issues

Community Expectations from Future NbS Interventions

Participants expressed interest in scaling and strengthening NbS practices, with expectations including:

- Large-scale watershed restoration using native species
- Spring and water source recharge programs
- Community ponds and small reservoirs for irrigation and livestock
- Riverbank protection with bioengineering measures
- Agroforestry promotion on private and community land
- Support for soil conservation and climate-resilient farming
- Forest fire management and early warning systems

Communities emphasized that NbS interventions should be long-term, integrated, community-led, and linked with capacity-building and livelihood incentives to ensure sustainability.

B. Midstream Areas of Kateni and Kandra River's Sub-watershed (Gauriganga Municipality– 7 & Ghodaghodi Municipality– 4 & 9)

The midstream communities of the Kateni and Kandra sub-watersheds maintain a strong dependence on natural resources for sustaining livelihoods, particularly agriculture, livestock rearing, fisheries, and forest-based activities. Their socio-ecological context comprising community forests, wetlands, river corridors, and agricultural landscapes forms the basis for both livelihood security and climate adaptation. Insights from FGDs, KIIs, and field observations highlight the current status of forest, soil, water, and land management, as well as existing and potential NbS practices.

i. Forest and Ecosystem Resources

Dependence on Community Forests, Wetlands, and River Systems

- Community forests provide essential resources: firewood, fodder, leaf litter for compost, NTFPs (e.g., broom grass, medicinal herbs), and timber for household needs.
- Wetlands, particularly in Ghodaghodi-4 and Ghodaghodi-9, support small-scale fisheries, water for livestock, and biodiversity habitats.
- River systems (Kateni and Kandra) are vital for irrigation, fishing, and supplementary livelihoods such as sand extraction and seasonal collection of aquatic plants.
- Communities use these natural resources for both subsistence and small-scale commercial purposes, especially among marginalized households.

Changes in Forest Cover, Water Sources, and Biodiversity

- Forest cover has remained stable in community forest-managed areas but is declining in unprotected buffer zones due to illegal logging, encroachment, and fuelwood extraction.
- Wetlands face sedimentation, invasive species proliferation (*Mikania micrantha*), and water level fluctuation due to upstream activities.
- River corridors are increasingly prone to erosion, reducing riverbank vegetation and biodiversity.

- Declines in native species (fodder trees, medicinal plants, fish varieties) were reported, affecting both livelihoods and ecosystem services.

Forest-User Group Involvement and Challenges

- Active Community Forest User Groups (CFUGs) manage forest protection, reforestation, and controlled resource extraction.
- Challenges include:
 - Inadequate funds and manpower for patrols and afforestation activities.
 - Limited technical knowledge for climate-resilient forest management.
 - Conflicts over resource use between upstream and midstream communities.
 - Invasive species management is weak.

ii. Soil, Water, and Land Use Issues

Soil Fertility and Erosion

- Soil fertility varies: low-lying agricultural lands near rivers are fertile but prone to waterlogging; sloping farmlands suffer from erosion during heavy rainfall.
- Continuous cultivation without sufficient organic matter addition has led to declining soil organic content.
- Observed erosion hotspots are located along riverbanks and marginal slopes, threatening productive lands and settlements.

Irrigation Systems and Water Sources

- Irrigation is partially available through small canals, wells, and pond systems. However:
 - Many canals suffer from siltation and leakage.
 - Wells and ponds dry up in late winter.
 - Seasonal variability and poor maintenance limit water access during dry periods.
- Rivers serve as secondary water sources but require significant labor for pumping and are prone to contamination during floods.

Water Scarcity Trends and Coping Strategies

- Dry season water scarcity has increased over the past 5–10 years, particularly for vegetable plots and kitchen gardens.
- Coping strategies include:

- Rotational irrigation prioritizing high-value crops.
- Water storage in ponds or tanks.
- Borrowing water from neighboring households or upstream canals.
- Diversifying crops toward drought-tolerant varieties.

Land Ownership, Tenancy, and Access

- Land distribution is uneven: medium-sized plots for Tharu and higher caste groups, marginal plots for Dalit and landless households.
- Tenancy and sharecropping exist, with landless households dependent on landlords.
- Access constraints limit the ability of marginalized groups to invest in long-term climate-resilient agriculture or NbS-linked enterprises.

iii. Awareness and Perceptions on Nature-based Solutions (NbS)

Community Awareness

- Awareness of NbS is limited but growing due to NRCS/IFRC/WWF engagement.
- Many community members have heard about activities such as riverbank plantation, wetland conservation, agroforestry, and pond restoration, though formal terminology “NbS” is less familiar.

Existing NbS Practices

- Riverbank plantation and bioengineering in Gauriganga-7 to reduce erosion.
- Wetland protection initiatives in Ghodaghodi-4 and Ghodaghodi-9, including silt removal, fencing, and community patrols.
- Agroforestry practices (fodder and fruit trees combined with crops) have been adopted in private lands.
- Pond and micro-reservoir restoration to enhance water availability for livestock and vegetables.

Perceived Benefits

- Reduction in soil erosion and flooding impacts.
- Improved fodder, timber, and NTFP availability.
- Increased water retention in ponds and wetlands.
- Enhanced biodiversity and ecosystem health.

- Opportunities for income generation through green enterprises (nursery management, bioengineering labor, fisheries).

Perceived Limitations

- Limited technical skills for implementation and maintenance.
- Financial constraints and lack of sustainable incentives.
- Conflicts over access to community forests or wetlands.
- Insufficient community ownership or long-term engagement.

Community Expectations from NbS

- Support in technical training, seedlings, and tools for plantation, agroforestry, and wetland restoration.
- Improved irrigation and water management linked with NbS interventions.
- Access to green income-generating activities such as fishery, honey production, and nursery management.
- Strengthening of local governance and CFUG capacity to sustain ecosystem-based interventions.
- Inclusion of women, youth, Dalit, and marginalized groups in planning and benefit-sharing.

C. Downstream Areas of Kateni and Kandra River's Sub-Watershed (Bhajani Municipality– 4 & Kailari Rural Municipality– 5)

The downstream and sub-watershed areas of the Kateni and Kandra rivers represent a dynamic socio-ecological landscape characterized by high dependence on natural resources, recurrent climate shocks, and growing land and water stresses.

Communities in Bhajani Municipality- 4 and Kailari Rural Municipality- 5 rely heavily on riverine ecosystems, wetlands, community forests, and agricultural lands for their livelihoods. However, rapid ecological degradation, changing hydrological regimes, and continued pressure on land resources have intensified community vulnerability. This section synthesizes FGD findings related to natural resource management and the existing or potential role of NbS.

i. Forest and Ecosystem Resources

Dependence on Forests, Wetlands, and River Systems

Local livelihoods are tightly intertwined with surrounding ecosystems. Community participants consistently emphasized high reliance on:

- River systems (Kateni, Kandra, Mohana):
Used for irrigation, fishing, livestock watering, sand and gravel extraction (informal), and seasonal floodplain cultivation (charland farming).
- Wetlands (Taal, Ghol, seasonal ponds):
These areas are vital for winter irrigation, livestock grazing, wild food collection (e.g., yam, mushrooms, and aquatic plants), and supporting biodiversity such as fish, turtles, and migratory birds.
- Community forests:
Although degraded in many places, forests provide fuelwood, fodder, leaf-litter, thatching materials, and limited NTFPs. Poor and marginalized households depend more heavily on forest resources due to limited land ownership.

Observed Changes in Forest Cover, Water Sources, and Biodiversity

Across both wards, participants reported notable ecological shifts:

- Forest cover increment and enhanced biomass availability due to protection, controlled grazing, and high reforestation efforts especially in Kailari RM.
- Shrinking wetlands and loss of natural ponds due to siltation, river course shifts, and expansion of farmland.
- Reduced year-round water availability, particularly during pre-monsoon months, with several seasonal rivulets drying sooner than in past decades.
- Increasing biodiversity, especially indigenous fish species (e.g., Asala, Magur), amphibians, and some wild medicinal plants.
- Increased invasive species, notably *Mikania micrantha* in forest patches and *Ipomoea* in wetlands.

Forest-User Group Involvement and Challenges

Community Forest User Groups (CFUGs) exist in several hamlets, but their capacity varies:

- Many CFUGs face limited financial resources, weak governance, and insufficient technical support.
- Women and marginalized groups expressed limited participation in decision-making, although they carry much of the burden for fuelwood and fodder collection.
- Regulating grazing, preventing encroachment, and mobilizing members for plantation are ongoing challenges.
- CFUGs reported a lack of coordinated water and forest planning at the watershed level, leading to piecemeal interventions.

ii. Soil, Water, and Land Use Issues

Soil Fertility and Erosion Status

Communities in Bhajani-4 and Kailari-5 identified soil degradation as a major concern:

- Frequent riverbank erosion along Kateni and Kandra rivers has resulted in loss of arable land.
- Declining soil fertility due to sand deposition from annual floods, excessive chemical fertilizer use, and reduced organic matter.
- Upland pockets (especially near forest margins) show increasing signs of sheet erosion and topsoil loss during intense rainfall events.

Water Sources, Irrigation Systems, and Emerging Issues

Water availability has become increasingly unpredictable:

- While some farmers use shallow tube wells, high pumping costs and groundwater depletion restrict year-round irrigation.
- Traditional kulo (canal) irrigation systems are poorly maintained and prone to damage from floods.
- River flow variation- low dry-season discharge, sudden monsoon surges- creates both water scarcity and flood risks.
- Several ponds and wetlands are experiencing drying and sedimentation, reducing their potential as natural water storage systems.

Water Scarcity Trends and Coping Strategies

Participants highlighted growing dry-season water shortages:

- Households increasingly depend on rainfed agriculture, limiting crop choices.
- Some communities adopt crop rotation and mulching, while others reduce winter planting entirely.
- Livestock owners travel longer distances to access water, especially during April–May.
- Women reported rising workloads and longer daily time spent fetching water.

Land Ownership, Tenancy, and Access to Productive Land

Land-related constraints are tightly linked to vulnerability:

- Small landholdings dominate (0.1–0.5 ha for most households), limiting livelihood diversification.
- A significant proportion of families especially Dalit, land-poor Tharu households are tenants or sharecroppers, limiting their control over decisions such as adopting conservation practices or investing in irrigation.
- Riverine erosion has created landlessness in certain pockets, pushing households toward wage labor and seasonal migration.

iii. Awareness and Perceptions on Nature-Based Solutions (NbS)

Community Awareness of NbS Activities

Awareness about the term “Nature-based Solutions” is generally low; however, communities recognize specific practices aligned with NbS when explained in practical terms. Participants identified several traditional and project-supported practices already present in the area.

Existing NbS Practices in the Sub-Watersheds

Communities reported the following interventions or practices resembling NbS:

- Riverbank plantation (bamboo, vetiver, sissoo) to control erosion.
- Wetland protection and seasonal ban on fishing in select areas.
- Agroforestry practices, including fruit tree planting along field boundaries.
- Community pond restoration for water storage and fish culture.
- Bio-fencing and bush interventions to prevent livestock encroachment.
- Use of local grass species (e.g., kans grass) for stabilizing flood-prone fields.

These interventions, though fragmented, demonstrate strong local demand for ecosystem-based approaches.

Perceived Benefits and Limitations of NbS Interventions

Benefits identified include:

- Reduced soil erosion and improved protection of farmlands from floods.
- Enhanced groundwater recharge through ponds and wetlands.
- Increased availability of fodder, fuelwood, and NTFPs from community forests.
- Support for biodiversity recovery, including fish and bird species.
- Lower long-term costs compared to built infrastructure.

Limitations noted include:

- Long gestation period for benefits (e.g., trees take years).
- Lack of technical support for selecting appropriate species.
- Inequitable access to restored resources—landless groups often benefit less.
- Poor maintenance and community follow-up after project completion.
- Insufficient integration with municipal plans and watershed governance.

Community Expectations from Future NbS Efforts

Across groups, communities expressed high expectations for stronger, more coordinated NbS interventions. Key priorities include:

- Riverbank stabilization using bamboo, vetiver, and mixed species at vulnerable erosion hotspots.
- Wetland revival to enhance water storage and increase winter irrigation.
- Integrated watershed management linking upstream, midstream, and downstream communities.
- Agroforestry and soil conservation on private and community lands.
- Support for community forest strengthening, including nurseries and controlled grazing systems.
- Livelihood-linked NbS, such as fishpond restoration, beekeeping near forest areas, and improved fodder systems.

Communities emphasized that effective NbS requires multi-stakeholder collaboration, long-term funding, inclusive participation of women and marginalized groups, and integration with local government climate resilience plans.

IV. Market Access, Value Chains and Economic Opportunities

A. Upstream Areas of Kateni and Kandra River's Sub-watershed (Mohanyal RM, Ward No. 5)

i. Overview

Mohanyal-5 is a predominantly rural, hill-riverine settlement where the economy is driven by smallholder agriculture, subsistence livestock rearing, forest-based products, seasonal wage labor, and limited off-farm activities. Despite substantial natural resources and traditional knowledge, market access remains weak, value chains are

underdeveloped, and communities capture only a small portion of potential economic benefits.

The remoteness of the upstream settlements, poor road conditions, limited financial services, and climate-induced shocks further constrain households' ability to diversify and commercialize livelihoods.

ii. Market Linkages

Primary Markets and Selling Practices

FGD participants reported that households primarily sell agricultural and livestock products through informal, fragmented, and small-volume channels. Typical market outlets include:

Local Village-Level Markets

- Small quantities of vegetables, eggs, milk, and poultry are exchanged locally within the ward.
- Transactions are mostly cash-based and informal.
- Prices are determined by buyers or local collectors, not producers.

Nearby Roadside Markets (Godawari, Attariya, Dipayal Corridor)

Farmers transport goods on foot or via shared jeeps to:

- Jhilmila Bazaar,
- Sahajpur,
- Attariya, and occasionally
- Dipayal/Tallodoti for livestock.

These are the key selling points for:

- Ginger, turmeric, beans, maize,
- Goats and poultry,
- NTFPs (Timur, Chiuri butter, medicinal herbs- mostly opportunistic and unorganized).

Middlemen / Local Collectors

Because of poor road connectivity, farmers often sell:

- Ginger, turmeric, broom grass (amriso), and goats to middlemen who visit the village seasonally. These intermediaries set the price and provide transport.

Current Market Reality

- The community has *supply-side potential* (ginger, turmeric, maize, goat rearing, broom grass, NTFP collection),
- But *demand-side linkages are weak*, with farmers largely dependent on opportunistic buyers and periodic markets.

iii. Access to Transportation, Roads & Collection Centers

Road Infrastructure

Mohanyal-5 is connected by earthen rural roads that remain:

- Highly seasonal,
- Frequently blocked by landslides,
- Difficult to traverse during June–September, disrupting market access when prices are highest.

FGD participants emphasized that:

- Transportation costs increase during the monsoon,
- Vehicles often refuse to travel to the upper settlements,
- Perishable products (vegetables, milk) spoil before reaching market.

Transportation Services

- Very limited; mostly small jeeps and motorbikes.
- High transport fares (up to 40–50% of selling price for small-volume producers).
- No organized mobile collection system for vegetables or livestock.

Collection Centers

- No functional collection center exists within the ward.
- Farmers requested community-level storage, weighing, and aggregation points, particularly for ginger, turmeric, broom grass, and goats.

iv. Major Market Challenges

From FGD, the following constraints surfaced prominently:

Low Farm-Gate Prices

- Middlemen dictate prices due to scattered production and lack of bargaining power.
- Farmers lack market information on prices and demand.

High Transportation Costs

- Transport accounts for a disproportionately high share of production cost.
- Difficult terrain restricts volume transport, reducing profitability.

Poor Market Information

- Prices for ginger, goats, vegetables, and NTFPs differ significantly across markets.
- Farmers rely on verbal information from traders, increasing vulnerability to exploitation.

Post-Harvest Losses

- High spoilage of vegetables, milk, and perishable items during monsoon.
- Absence of storage or processing facilities.

Climate-Related Disruptions

- Landslides block roads, cutting off access for weeks.
- Erratic rainfall reduces production, lowering marketable surplus.

v. Financial Services, Access to Credit, and Inclusion

Availability of Financial Institutions

FGD responses indicate the presence of:

- 2 to 3 savings and credit cooperatives,
- A few microfinance institutions operating mostly at ward/market centers,
- Informal groups such as savings groups and women's cooperatives.

However, many settlements in the upstream area remain out of formal coverage due to remoteness.

Access to Loans

Formal Loans

- Households can access loans from cooperatives (1–3 lakh NPR range), but:
 - Interest rates are often high (18–24% annually),
 - Collateral requirements exceed the capacity of poorer households,
 - Loan processing is slow for agricultural purposes.

Informal Lending

- Borrowing from neighbors or local moneylenders at even higher interest (24–36% annually).
- Used mainly for emergencies and livestock purchase.

Barriers to Access

FGD participants highlighted:

- Limited financial literacy,
- Lack of collateral,
- Distance to branches,
- Requirement of group guarantee by microfinance.

Women and marginalized families noted additional difficulties in navigating paperwork and meeting group savings obligations.

iv. Access to Finance for Women, Youth, Marginalized & Indigenous Groups

Women

- Women actively participate in savings groups but have limited decision-making power over loan use.
- Loans obtained in women's names are typically controlled by male family members.
- Women face mobility constraints and lack exposure to larger business opportunities.

Youth

- Youth face:
 - High migration rates,
 - Lack of seed capital for enterprises,
 - Minimal access to entrepreneurship training.

Most youth rely on migration to India for seasonal income.

Marginalized and Indigenous Groups

Includes Dalit families and Tharu/Janajati households:

- Often land-poor, limiting collateral for credit,
- Pay higher informal interest rates,
- Face discrimination in accessing microfinance groups,
- Are more vulnerable to climate shocks and financial exclusion.

vii. Potential Value Chains with Market Promise

Based on FGD insights and field observations, the following value chains have significant potential:

Ginger and Turmeric

- High suitability in hill agro-ecology.
- Strong demand in Attariya–Dhangadhi markets.
- Requires:
 - Improved seed rhizomes,
 - Soil conservation on sloped fields,
 - Collection centers,
 - Market contract linkages.

Goat Rearing (Khasi Value Chain)

- Strong local and cross-border demand.
- Requires:
 - Improved sheds,
 - Fodder management,
 - Vet services,
 - Organized supply through cooperatives.

Broom Grass (Amriso)

- Potential as a climate-resilient crop for degraded slopes.
- Market demand for brooms and raw fiber.
- Needs:
 - Aggregation mechanism,
 - Linkages with fiber/broom industries in Kailali.

Vegetables (Off-season)

- High profitability but vulnerable to transport disruption.
- Could expand with:
 - Plastic tunnels,
 - Water harvesting ponds,
 - Collection centers.

NTFPs & Forest-based Products

- Timur, Chiuri butter, Tejpat medicinal herbs (Kurilo- community-managed).
- Requires sustainable harvesting protocols and market mapping.

Horticulture Products

Horticulture products like Orange, Kiwi, etc. are agro-climatically suitable for production.

viii. Economic Opportunities and Entry Points for NbS-Based Livelihoods

To strengthen market-oriented livelihoods in a climate-sensitive upstream area, the following opportunities stand out:

Promoting Climate-Resilient High-Value Crops

- Ginger, turmeric, broom grass, and chiuri are erosion-resistant and suitable for sloped terrain.
- Integration with soil conservation/terracing under NbS.

Strengthening Producer Groups and Cooperatives

- Aggregation can reduce transport cost and improve bargaining power.

- Collective marketing of ginger, turmeric, vegetables, and goats.

Establishing Local Collection and Bulking Points

- Prioritize Kateni–Kandra settlements for a multi-purpose collection shed with weighing and storage.

Improving Rural Road and Trail Maintenance

- Integrate youth groups, women groups, and forest user groups for slope stabilization and road safety (bio-engineering).

Expanding Access to Finance

- Tailored financial products for:
 - Women entrepreneurs,
 - Goat-rearing households,
 - Climatically vulnerable groups.

Skills and Entrepreneurship Training

- Goat rearing, nursery development (broom grass/NTFPs), ginger value addition (drying, slicing), and basic business management.

B. Midstream Areas of Kateni and Kandra River's Sub-watershed (Gauriganga Municipality– 7 & Ghodaghodi Municipality– 4 & 9)

The midstream communities of Gauriganga- 7 and Ghodaghodi- 4 & 9 rely on both subsistence and market-oriented livelihoods. While agriculture, livestock, fisheries, and forest-based activities form the primary livelihood base, market access, value chains, and financial inclusion play a critical role in determining income stability, resilience to climate shocks, and potential for diversification.

i. Market Linkages

Farm and Livestock Product Sales

- Agricultural produce: Paddy, wheat, maize, vegetables (tomato, cauliflower, chili, cucumber), pulses, and oilseeds are primarily sold at local markets such as Gauriganga Bazar, Ghodaghodi Bazar, Dhangadhi, and smaller ward-level collection points.

- Livestock products: Milk, buffalo, goats, and poultry are sold through local cooperatives, small traders, or directly to neighboring municipalities.
- NTFPs and fisheries: Mushrooms, medicinal herbs, broom grass, and fish from wetlands are occasionally sold to local traders or small market centers.

Access to Roads, Transportation, and Collection Centers

- The road network connecting these wards to major market centers is partially paved; farm-to-market roads are often unpaved and become difficult to traverse during monsoon.
- Transportation for agricultural produce relies on small trucks, motorcycles, or hand carts. Limited access to cold storage restricts perishable vegetable and milk sales.
- Collection centers operated by cooperatives or trader networks exist but are unevenly distributed; many households travel 2 to 5 km to reach the nearest center.

Challenges in Selling Products

- Low farm-gate prices due to the presence of middlemen who dictate rates.
- High transportation costs during the monsoon season increase the net cost of selling produce.
- Market volatility reduces profitability of perishable crops, particularly vegetables and milk.
- Limited bargaining power for smallholder farmers, women, and marginalized groups reduces income potential.
- Seasonal surpluses often remain unsold or are sold at discounted prices, especially for vegetables and pulses.

ii. Financial Services

Access to Microfinance, Cooperatives, and Savings Groups

- Midstream households access finance primarily through local cooperatives, savings and credit groups, and microfinance institutions.
- Cooperatives provide short-term loans for crop inputs, livestock purchase, and small businesses.
- Savings groups, often women-led, offer small but flexible loans and promote financial literacy.
- Bank penetration is low; formal financial institutions are mostly in municipal centers, making access time-consuming for remote households.

Loan Availability and Limitations

- Loans are available for agriculture, livestock, and small enterprises, but:
 - Collateral requirements exclude many marginalized households.
 - Loan amounts are often insufficient for medium-scale investment (e.g., irrigation infrastructure, greenhouse farming).
 - Interest rates from microfinance providers are relatively high.
 - Awareness of government subsidy programs and insurance schemes is limited.

Inclusion of Women, Youth, and Marginalized Groups

- Women: Participation in savings groups is common, but access to larger loans or market-based finance remains limited.
- Youth: Younger community members face difficulty in obtaining start-up capital for enterprises such as vegetable farming, beekeeping, or poultry.
- Marginalized and indigenous groups: Dalit, landless, and smallholder households often face systemic barriers in accessing credit due to lack of collateral, social exclusion, and limited financial literacy.
- Positive trend: Some cooperatives and NGOs are increasingly targeting inclusive financial services for these groups, though scale and sustainability are limited.

iii. Economic Opportunities and Value Chain Potentials

Agricultural Value Chains

- Vegetables, pulses, oilseeds, and spices offer marketable potential if linked to collection centers, cooperatives, and small-scale agro-processing.
- Paddy and maize remain staple crops; value addition through parboiling, milling, or organic branding can improve income.

Livestock and Dairy

- Small ruminants (goats, sheep) and dairy production offer high-potential income streams, particularly if market linkages and cold storage are improved.
- Cooperative-based milk collection networks could enhance both quality and price realization.

Fisheries and Wetland-Based Enterprises

- Ghodaghodi wetlands and irrigation ponds present opportunities for small-scale aquaculture, seasonal fish farming, and fish value addition.
- Wetland restoration can also support eco-tourism and seasonal NTFP harvesting.

Forest and NTFP Value Addition

- Broom grass, medicinal herbs, and fuelwood can generate income through cooperative-based collection, processing, and marketing.
- Agroforestry integration provides both fodder and commercial fruit/nut production opportunities.

Climate-Smart and NbS-Linked Enterprises

- Riverbank plantations, tree nurseries, and flood-resilient agroforestry provide employment and green income streams.
- Beekeeping and honey production associated with NbS activities offer supplementary income for women and youth.
- Pond restoration and fisheries development align with ecosystem-based livelihood enhancement.
- Homestay promotion for exploring and capitalizing potentials of nature based tourism due to presence of Ghodaghodi Lake in the sub-watershed.

C. Downstream Areas of Kateni and Kandra River's Sub-Watershed (Bhajani Municipality– 4 & Kailari Rural Municipality– 5)

The downstream communities of Bhajani Municipality–Ward 4 and Kailari Rural Municipality–Ward 5 operate within a semi-commercial rural economy where agriculture, livestock, and wage labor form the backbone of household incomes. Market access and value chain engagement remain central to livelihood strategies, yet are significantly constrained by infrastructure gaps, limited bargaining power, climate-induced production volatility, and unequal access to financial services. This section synthesizes community perspectives on market linkages, value chain participation, financial accessibility, and emerging economic opportunities.

i. Market Linkages

Local and Regional Market Destinations

Communities primarily sell their agricultural produce and livestock in nearby markets located within Bhajani, Tikapur, and sometimes Dhangadhi. Based on FGDs, market channels typically include:

- Local haat bazaars (Bhajani, Lalbojhi, Masuriya) for small-volume sales of vegetables, fish, eggs, and poultry.
- Roadside vendors and mobile collectors who purchase paddy, wheat, mustard, vegetables, milk, and goats directly from the village.
- Cooperatives and small collectors for milk, although access varies by settlement.
- Regional traders from Tikapur and Dhangadhi for bulk commodities such as paddy, lentils, turmeric, and goats.

Livestock particularly goats are generally sold at cross-district markets such as Attariya or at festival-season temporary markets. Fishers from riverine settlements often sell fresh fish to local collectors who transport them to Tikapur and Dhangadhi.

Access to Roads, Transportation, and Collection Centers

Infrastructure improvements in both municipalities have enhanced mobility, yet several constraints persist:

- Gravel roads connect most villages to municipal centers, but these become muddy or impassable during monsoon, delaying transportation of perishable goods.
- Limited availability of collection centers- only a few cooperatives operate milk or vegetable collection points, and many farmers must travel long distances or rely on middlemen.
- High transportation costs due to small-scale production and poor road quality reduce farmers' profit margins.
- Lack of cold storage or post-harvest handling facilities, particularly for vegetables, dairy, fish, and fruits.

Communities from low-lying, flood-prone hamlets face seasonal restrictions in accessing markets, often waiting until floods recede or taking longer detours to reach the main road.

Challenges in Selling Products

FGDs highlighted several recurring challenges:

- Low farmgate prices due to weak bargaining power and dominance of middlemen.
- High dependence on informal traders, who often set prices unilaterally.
- Price volatility, especially for vegetables, milk, and goats during monsoon or festival periods.
- Crop loss and reduced quality from floods, heavy rainfall, drought, and pest outbreaks, which make market participation unpredictable.
- Limited market information, such as prevailing prices, demand trends, or seasonal opportunities.
- Small production volumes that inhibit collective marketing or negotiation for better prices.

Women and marginalized groups, although active in production, face additional constraints like mobility restrictions, lack of access to transport, and limited involvement in market decisions.

ii. Financial Services and Economic Inclusion

Access to Microfinance, Cooperatives, and Savings Groups

The financial landscape in the sub-watershed area is diverse but uneven in accessibility:

- Local cooperatives (multipurpose, agriculture, and women-led cooperatives) are the most trusted sources for savings and small loans.
- Microfinance institutions (MFIs) are expanding their presence, offering group-based loans with relatively easy procedures.
- Community savings groups such as mothers' groups, women's groups, or farmers' groups play an important role in helping households manage small-scale financial needs and emergencies.

However, communities expressed that interest rates vary widely, with some MFIs charging significantly high rates, creating repayment pressure on households with unstable incomes.

Loan Availability and Limitations

While loans are available in principle, several barriers limit their effective use:

- Collateral requirements- households without land ownership or with river-erosion-affected plots struggle to access loans from formal banks.
- Small loan sizes, especially from cooperatives, are insufficient for larger investments such as livestock expansion, irrigation pumps, or climate-resilient technologies.
- Strict repayment schedules do not align with agricultural production cycles, putting stress on borrowers.
- Limited financial literacy, particularly among older women and indigenous groups, restricts proper utilization and management of loans.
- Fear of indebtedness, due to unstable climate-sensitive incomes, discourages some households from borrowing.

Access to Finance Among Women, Youth, Marginalized and Indigenous Groups

Vulnerability and exclusion intersect strongly with financial access:

- Women participate actively in savings groups but often require approval from male household members to take larger loans. Access to information on financial products is limited.
- Youth face challenges due to lack of collateral, limited credit history, and fewer youth-focused enterprise development programs.
- Marginalized caste groups (Dalit, land-poor Tharu households) are more dependent on MFIs than on banks or cooperatives due to lack of land and formal documentation.
- Indigenous Tharu communities rely heavily on seasonal migration and wage labor, making loan repayment difficult and discouraging investment in longer-term enterprises.

Despite these barriers, communities expressed strong interest in expanding financial access to support off-farm enterprises such as tailoring, grocery shops, goat and poultry rearing, fish farming, and small-scale agri-processing.

iii. Emerging Economic Opportunities and Constraints

Discussions revealed several sectoral opportunities that could enhance climate-resilient livelihoods:

Promising Opportunities

- Livestock value chains (goat rearing, backyard poultry) with potential for scale-up.
- Fish farming in restored ponds and wetlands, especially given high local and regional demand for fresh fish.
- Vegetable- off-season and riverbed and fruit production (watermelon, cucumber, tomato, brinjal, mango, banana) for local and regional markets.
- Agroforestry-based enterprises such as broom grass, bamboo, duna tapari, fodder trees, and MAPs/NTFPs.
- River-based enterprises, including sustainable fishing, eco-tourism, and bamboo-based handicrafts.
- Agri-processing, hulling, oil pressing, pickles, dried fish, and turmeric processing subject to training and market linkages.

Key Constraints to Unlocking Opportunities

- Limited start-up capital and high input costs.
- Poor technical knowledge about climate-tolerant farming practices.
- Lack of organized producer groups for collective marketing.
- Absence of linkage with wholesalers, processors, and large buyers.
- Climate shocks (floods, droughts) that reduce production reliability, discouraging buyers.
- Dependence on external traders for price information and transportation.

V. Coping Strategies and Community Resilience

A. Upstream Areas of Kateni and Kandra River's Sub-watershed (Mohanyal RM, Ward No. 5)

i. Overview

Households in Mohanyal-5 experience recurrent climate-induced shocks—irregular rainfall, prolonged dry spells, flash floods, landslides, crop pests, declining soil fertility, and water scarcity. These stresses heavily affect agriculture, livestock, and food security, compelling families to adopt a combination of short-term coping strategies and long-term resilience practices.

The FGD findings show that many coping mechanisms remain reactive and often

harmful, while resilience capacities are emerging but insufficiently supported by infrastructure, financial systems, and extension services.

ii. Current Household Coping Mechanisms

Borrowing Money and Taking Loans

- Households often borrow from local cooperatives, microfinance institutions, neighbors, or informal moneylenders.
- Loans are used to buy food, purchase livestock feed during fodder shortages, or meet medical needs after climate-related illness or injuries.
- Interest rates are high, making this strategy unsustainable, especially for land-poor and marginalized families.
- Women noted that loan repayment pressure increases household stress and sometimes leads to distress migration.

Selling Livestock

- Households commonly sell goats, pigs, or poultry during crisis periods—particularly after crop failure or extended lean seasons.
- Livestock serves as a “living bank,” but frequent sale of productive animals reduces long-term income potential.
- Distress sale is more prevalent during:
 - Monsoon landslides (when maize crops are damaged),
 - Winter droughts (water scarcity for livestock),
 - Health emergencies following extreme weather events.

Seasonal and Distress Migration

- Men and youth migrate to India (Pithoragarh, Bareilly, New Delhi) or to urban centers in Nepal (Dhangadhi, Mahendranagar) for seasonal wage labor.
- Climate shocks (crop loss, fodder shortage, drying springs) accelerate migration decisions.
- Migration income is used to buy food, repay loans, and purchase agricultural inputs.
- While migration reduces immediate financial shock, it weakens community cohesion and increases workload for women.

Reducing Food Intake and Dietary Diversity

- During droughts or poor harvests, households reduce:
 - Number of meals per day (often 2 instead of 3),
 - Consumption of vegetables and protein-rich foods,
 - Quantity of rice and lentils.
- Female-headed households and marginalized communities are more likely to adopt food compromises.
- This is a harmful coping strategy, increasing malnutrition risk.

Increased Reliance on Forest Resources

- Forests in the upper watershed become critical safety nets during climate shocks. Households collect:
 - Wild tubers, mushrooms, fruits, edible shoots,
 - Firewood and bedding materials,
 - Timber for house repairs after landslides.
- Over-harvesting during stress periods contributes to degradation of community forests.

Relying on Social Support Networks

- Families borrow grain or cash from neighbors and relatives.
- Community groups (women's groups, savings groups) support vulnerable families during illness, funerals, or crop failure.
- Social support remains strong, but its capacity is strained by repeated climate events that affect all households simultaneously.

Short-Term Labor

- Some households engage in daily labor, including stone quarrying or road construction.

iii. Sustainability of Current Coping Mechanisms

Based on FGD analysis, coping strategies can be categorized as follows:

Unsustainable / Harmful Mechanisms

- High-interest borrowing from informal lenders
- Selling productive livestock
- Reducing food intake

- Over-dependence on forest resources
- Charcoal production
- Distress migration of youth

These mechanisms erode long-term resilience by reducing asset bases and degrading natural resources.

Moderately Sustainable Mechanisms

- Short-term wage labor
- Using community-level support networks
- Borrowing small loans from cooperatives

These help households recover from minor shocks but are insufficient during severe or repeated climate events.

Sustainable Mechanisms (Promising but Limited)

- Adoption of drought-tolerant varieties
- Use of mulching and water conservation
- Small-scale agroforestry integration
- Participation in savings groups

While these show resilience potential, limited training, poor extension services, and lack of infrastructure constrain broader adoption.

iv. Community Resilience Practices

Use of Drought-Tolerant Seeds and Improved Varieties

- Farmers have begun shifting to drought-tolerant local landraces of maize, millet, cowpea, and beans.
- Adoption remains limited due to poor availability of quality seed and minimal extension support.
- FGD participants expressed interest in drought-tolerant vegetables and improved ginger/turmeric rhizomes.

Water Harvesting, Soil Moisture Management, and Mulching

Households increasingly practice:

- Mulching of vegetable beds to conserve moisture,

- Rainwater harvesting using plastic drums,
- Small pits/ponds for kitchen gardens,
- Contour bunding and small stone bunds on sloped farms.

However:

- Lack of materials (plastic ponds, pipes) limits adoption,
- Land fragmentation and steep slopes restrict scaling.

Agroforestry, Tree Planting & Slope Stabilization

Communities practice:

- Integration of fodder trees (bakaino, kimbu, uttis) with crops,
- Planting broom grass (amriso) on degraded slopes,
- Maintaining community forest boundaries to reduce landslides.

These practices strengthen ecosystem resilience but need technical guidance to optimize benefits.

Adoption of Climate-Smart Agriculture (CSA) & IPM

A few progressive farmers apply:

- Mixed cropping and crop rotation to reduce pest outbreaks,
- Improved goat sheds and fodder management,
- Organic pest repellents (neem solution, urine-based mixtures),
- Small-scale drip irrigation (in 2–3 households).

But CSA adoption remains low due to:

- Insufficient extension visits,
- Lack of demonstration plots,
- Financial constraints for tools and equipment.

Migration as a Long-Term Adaptation Strategy

While often seen as coping, migration also contributes to resilience when managed proactively:

- Migrant remittances help build houses, buy livestock, invest in education, and manage climate risks.

- However, households remain vulnerable if migration income is unstable or if climate shocks occur simultaneously for extended families.

Social Capital and Collective Resilience

Strong collective action plays a critical role in climate resilience:

Community Groups

- Women's groups, savings and credit groups, forest user groups (CFUGs), and agricultural groups provide a platform for joint action.
- Community labor sharing ("parma") helps repair irrigation canals, maintain trails, and support households facing sudden climate shocks.

Kinship Networks

- Relatives within the ward and neighboring wards provide cash, seeds, or labor during crisis periods.
- Extended family networks support temporary relocation during landslides.

Social capital remains one of the strongest resilience assets, though increasingly strained by outmigration.

v. Emerging Resilience Gaps and Constraints

Despite the presence of promising practices, significant gaps remain:

- Weak access to financial services limits ability to invest in adaptation.
- Poor and climate-vulnerable road infrastructure isolates households during shocks.
- Lack of water storage structures undermines resilience during prolonged droughts.
- Minimal government and extension presence delays adoption of CSA and NbS practices.
- Youth outmigration reduces labor availability for community-based resilience work.
- Fragmented landholdings limit implementation of large-scale soil and water conservation.

B. Midstream Areas of Kateni and Kandra River's Sub-watershed (Gauriganga Municipality– 7 & Ghodaghodi Municipality– 4 & 9)

The midstream communities of Gauriganga–7 and Ghodaghodi–4 & 9 face increasing climate variability and environmental stressors, including irregular rainfall, floods, waterlogging, droughts, and heatwaves. These hazards directly threaten livelihoods, food security, and income stability. In response, households and communities have developed a range of coping mechanisms and resilience practices. These strategies vary across socio-economic and gender groups and reflect both traditional knowledge and emerging climate-smart interventions.

i. Current Coping Mechanisms

Communities employ multiple strategies to manage climate-related shocks:

Financial coping

- Borrowing money from relatives, neighbors, cooperatives, or microfinance institutions to cover agricultural losses or household needs.
- Selling livestock, poultry, or small assets during prolonged droughts or post-flood losses to generate emergency cash.

Livelihood diversification

- Engaging in wage labor locally or migrating temporarily to nearby municipalities or India during agricultural off-seasons.
- Expanding income sources to forest-based activities, such as collecting firewood, fodder, or NTFPs (broom grass, medicinal herbs, mushrooms).

Food management

- Reducing food intake during scarcity periods, particularly in poor and landless households.
- Relying on stored grains or shared food resources among relatives and neighbors.

Migration

- Seasonal or temporary migration of men and youth to urban centers or India for wage work is a common coping mechanism during crop failure or livestock loss.

- Migration can relieve household pressure but often increases the workload of women and elderly family members left behind.

Dependence on natural resources

- Increased reliance on wetlands, rivers, and community forests for fodder, fish, water, and NTFPs during periods of climatic stress.
- Overuse of these resources during crises can threaten long-term sustainability.

Assessment of Sustainability

- Many coping mechanisms are short-term and reactive, such as selling livestock or reducing food intake, and may undermine long-term resilience.
- Borrowing and high-interest loans can lead to debt cycles, especially among poor households.
- Migration relieves immediate pressure but does not address systemic vulnerabilities and may create social burdens at home.

ii. Community Resilience Practices

In addition to coping strategies, midstream communities are adopting proactive practices to reduce climate vulnerability and build long-term resilience:

Climate-Smart Agriculture (CSA)

- Use of drought-tolerant and early-maturing seed varieties for paddy, maize, and vegetables to cope with irregular rainfall.
- Integrated Pest Management (IPM) to reduce crop losses from pest and disease outbreaks.
- Mulching and organic manure application to retain soil moisture and improve fertility.

Water Management and Harvesting

- Construction of ponds, rainwater harvesting structures, and small check dams to supplement irrigation during dry spells.
- Maintenance of canals and drainage systems to minimize waterlogging and soil erosion during heavy rains.

Agroforestry and Natural Resource Management

- Planting fodder trees, fruit trees, and riverbank vegetation to stabilize soil, reduce erosion, and enhance biodiversity.
- Participation in community forest and wetland conservation initiatives as part of NbS interventions, providing both ecological and livelihood benefits.

Migration and Social Capital

- Seasonal labor migration as a diversified income source.
- Support networks within families, cooperatives, and savings groups help households access labor, credit, and food during crises.
- Mutual assistance and parma (community labor exchange) strengthen resilience at the neighborhood level.

Emerging Practices

- Some households are experimenting with small-scale aquaculture, beekeeping, and greenhouse vegetables to buffer against climate-induced losses.
- Local youth groups are increasingly engaged in NbS-linked enterprises, such as nursery management and riverbank plantation, providing both income and ecosystem benefits.

iii. Key Observations

- Communities demonstrate a mix of reactive and proactive strategies, with greater reliance on short-term coping for immediate shocks.
- Proactive measures such as CSA, water harvesting, and agroforestry are unevenly adopted, often limited by access to technical knowledge, credit, and irrigation infrastructure.
- Women, youth, and marginalized groups often face barriers in accessing resilience-building resources, training, and decision-making.
- Social cohesion and community groups provide critical support, enhancing collective capacity to respond to floods, droughts, and other climate events.

C. Downstream Areas of Kateni and Kandra River's Sub-Watershed (Bhajani Municipality– 4 & Kailari Rural Municipality– 5)

The households of Bhajani Municipality- 4 and Kailari Rural Municipality- 5 face recurring climate hazards including annual floods, riverbank cutting, prolonged dry spells, waterlogging, and erratic rainfall that significantly disrupt agricultural

production, livestock management, and wage labor opportunities. In response, communities engage in a range of short-term coping mechanisms and long-term resilience practices, which together shape their capacity to deal with future climate risks. The following presents a detailed synthesis of community-reported strategies, their sustainability, and emerging resilience trends.

i. Current Coping Mechanisms

Borrowing and Financial Reliance

Households frequently cope with immediate losses from floods or crop failure by borrowing money, primarily from:

- Local cooperatives
- Microfinance institutions
- Informal lenders (moneylenders)
- Relatives and neighbors

Loans are typically used for food purchases, agricultural inputs, house repairs, and emergency health expenses. However, high interest rates especially from MFIs and informal lenders often lead to debt accumulation, making loan-based coping financially unsustainable for many households.

Sale of Livestock and Productive Assets

During climate shocks, families commonly sell goats, cows, poultry, or farm tools to secure cash. While this provides short-term relief, frequent or repeated sales of productive assets undermine:

- Household income sources
- Nutritional security
- Future livelihood recovery

This practice is assessed as a harmful coping mechanism when repeated over multiple climate events.

Seasonal and Distress Migration

Migration is a pervasive coping strategy:

- Men migrate to India for short-term labor work during flood or drought periods.

- Youth migrate seasonally to urban centers for construction, rickshaw pulling, and factory labor.
- Some households depend on remittances to rebuild homes and recover livelihood losses.

While migration provides income diversity, the community reports negative impacts such as increased workload on women, emotional stress, reduced household labor availability, and weakened community cohesion.

Dependence on Forests and Natural Resources

During hardship, households increase extraction of:

- Fuelwood
- Fodder
- Wild fruits and roots
- Fish from rivers and wetlands
- Sand/aggregate from riverbeds (often informally)

Although essential for survival, overharvesting especially after floods or drought contributes to ecosystem degradation, making this a partly harmful and unsustainable coping strategy.

Reducing Food Consumption and Dietary Diversity

Women's groups in Bhajani- 4 and Kailari- 5 reported that during peak stress periods:

- Households reduce meal frequency
- Dietary diversity declines
- Women often eat last or reduce their portion to feed children

This practice has clear nutritional risks, especially for pregnant women, children, and elderly individuals.

Informal Labor and Daily Wage Work

During agricultural losses, communities rely heavily on daily wage labor in nearby towns or brick kilns. However, demand fluctuates seasonally, and wages are often low, creating unstable and precarious coping conditions.

ii. Community Resilience Practices

Despite multiple vulnerabilities, the downstream communities have adopted several proactive measures that strengthen resilience over time.

Adoption of Climate-Resilient Farming Methods

A number of households have begun integrating climate-smart agricultural (CSA) practices, including:

- Drought-tolerant and short-duration crop varieties, especially in drought-prone hamlets.
- Mulching with straw and leaves to conserve soil moisture.
- Kitchen garden promotion using wastewater in water-scarce months.
- Community-level crop diversification- vegetables, mustard, pulses to reduce reliance on single crops.
- Integrated Pest Management (IPM) practices, including use of botanical pesticides and pheromone traps.

These practices are increasing but not yet adopted at scale due to limited awareness, technical support, and access to inputs.

Water Harvesting and Localized Irrigation Solutions

In water-scarce downstream areas, communities reported adopting:

- Small household ponds for water storage
- Reuse of wastewater for vegetable gardens
- Low-cost lift irrigation systems along river edges
- Community-constructed canals and temporary diversions

However, floods frequently damage these systems, highlighting the need for more durable and supported infrastructure.

Agroforestry and Vegetative Measures

Some settlements, especially those near riverbanks and degraded lands, have initiated:

- Plantation of fodder trees (bakaino, ipil-ipil, sissoo, etc.)
- Agroforestry on farmland edges
- Grass planting (broom grass, kans, vetiver) on erosion-prone areas

These interventions provide multiple services- fodder, fuelwood, slope stabilization, and reduced flash-flood impacts demonstrating strong potential for NbS expansion.

Migration as a Resilience Strategy

Although migration is largely a coping strategy, it also functions as a long-term resilience approach for households that use remittances to:

- Invest in livestock
- Improve housing
- Purchase land
- Pay for children's education
- Maintain a financial buffer for future climate shocks

However, dependence on migration without parallel local livelihood strengthening remains a vulnerability.

Social Capital and Collective Support Systems

Strong social networks play a crucial resilience role:

- Relatives and neighbors share food, labor, and small loans during crises.
- Women's groups, mother groups, and saving groups provide emotional and financial support.
- Farmers collaborate informally to repair embankments, irrigation canals, and access roads after floods.
- Community organizations- cooperatives, farmer groups, and forest-user groups offer platforms for collective action.

These social structures help households recover faster, though their capacity is limited during large-scale climatic shocks.

iii. Effectiveness and Sustainability of Existing Strategies

An assessment of strategies indicates:

More Sustainable and Resilience-Building Practices

- Climate-smart agriculture (CSA)
- Agroforestry and vegetative riverbank protection
- Crop diversification
- Water harvesting and small irrigation

- Community savings and cooperative-based financial systems
- Social capital and group-based support

Less Sustainable or Harmful Coping Practices

- Borrowing high-interest loans
- Selling productive livestock
- Overextraction of forest and river resources
- Distress migration
- Reduced food intake
- Excessive dependence on middlemen for income recovery

Strengthening the former and reducing reliance on the latter is essential for enhancing community resilience.

VI. Climate-Smart Livelihood Potentials

A. Upstream Areas of Kateni and Kandra River's Sub-watershed (Mohanyal RM, Ward No. 5)

i. Overview

The upstream communities of Mohanyal-5 face increasing climate risks- erratic rainfall, prolonged dry spells, declining soil fertility, frequent pest outbreaks, drying springs, and episodic flash floods. These environmental changes are reshaping traditional farming livelihoods. During FGDs, local farmers, women's groups, livestock owners, youth, and marginalized households identified a set of feasible climate-smart livelihood options that can enhance income, reduce climate vulnerability, and strengthen ecosystem resilience.

These options draw on the area's comparative advantages: diverse agro-ecology, abundant natural vegetation, availability of fodder species, traditional knowledge of herbal plants, and access to small local markets.

ii. Feasible Climate-Smart Livelihood Options Identified by the Community

Climate-Resilient Crop Options

Farmers highlighted several crops with better performance under changing climatic conditions:

Drought-Tolerant Cereals and Pulses

- Millet, sorghum, and finger millet (kodo) – strong resilience to heat and low water; suitable for sloping and marginal land.
- Cowpea, black gram, horse gram – require limited irrigation and mature quickly.

Climate-Resilient Vegetables

- Off-season vegetables (tomato, chili, beans, cauliflower) under low-cost polyplastic tunnels.
- Drought-resilient vegetables like pumpkin, gourds, taro, sweet potato – well-suited to dry spells.
- Indigenous leafy greens (nettles, stinging nettle, ferns) have strong local demand and short growing cycles.

High-Value Climate-Resilient Cash Crops

- Turmeric, ginger, timur (Sichuan pepper), cardamom (small-scale trial) – well-performing under partial shade and improved soil moisture.
- Medicinal and aromatic plants (MAPs) including lemongrass, citronella, tulsi, and ashwagandha – require low inputs and are drought tolerant.

Agroforestry-Based Productivity Enhancement

- Integration of fruit trees (citrus, mango, litchi, guava) with fodder species and crops.
- These systems combine income with soil moisture conservation and slope stability.

Livestock Diversification and Improvement

Goat and Sheep Rearing (Major Potential)

- Increasing demand in local and regional markets (Dhangadhi, Atariya).
- Abundant fodder from community forests.
- Goats are highly resilient to heat and drought stress.

Potential improvements include:

- Stall-feeding systems,
- Commercial fodder development,
- Improved breeds (Boer cross, Khari improved).

Improved Backyard Poultry

- Local breeds (Shakhini, Giriraj) show higher resilience to diseases.
- Low investment and quick returns suitable for women and poor households.

Pig Rearing

- Strong market demand in nearby hill communities.
- Viable for Dalit households traditionally engaged in this activity.

Beekeeping (Honey and Pollination Services)

- High potential due to diverse vegetation and flowering plants.
- Suitable for youth and women entrepreneurs.
- Enhances pollination and supports overall ecosystem health.

Opportunities in Fisheries and Aquatic Resource Management

Due to drying springs and variable water availability, large-scale pond fishery is limited. However:

- Small household ponds can be used for integrated fish–vegetable systems.
- Wetland restoration initiatives can revive native fish and aquatic biodiversity, creating prospects for community-managed fishing.

Women highlighted potential for selling dry fish and value-added aquatic products if wetlands are restored.

Nature-Based and Green Enterprise Options**Nurseries for Climate-Resilient Plants**

High interest from communities in:

- Seedling nurseries for fodder trees, fruit trees, broom grass (amriso), and MAPs.
- Such nurseries support NbS interventions and create local employment.

Riverbank Plantation Management

- Community groups are willing to engage in bamboo, vetiver, amriso, and willow plantation along fragile slopes and riverbanks.

- These activities stabilize soil, reduce flood risk, and generate income from bamboo poles, broom grass, and biochar products.

Nature based Tourism and Cultural Tourism

- Potential for short trekking routes, homestays, and wild food tourism due to scenic upper watershed landscapes.
- Requires basic infrastructure and training.

NTFP Value Addition and Green-Based Enterprises

- Drying, processing, and packaging of turmeric, ginger, herbs, and wild spices (timur).
- Making herbal teas, essential oils (lemongrass), and natural soaps.
- Collection and processing of broom grass for value-added brooms.

These options provide high returns and are climate-resilient by nature.

iii. Required Support to Promote Climate-Smart Livelihoods

Skills and Capacity Development Needs

FGD participants highlighted gaps in technical know-how. The following training and support are crucial:

For resilient agriculture

- Climate-smart agricultural practices (mulching, micro-irrigation, drip systems).
- Low-cost greenhouse/tunnel farming training.
- Organic farming and Integrated Pest Management (IPM).
- Seed production and storage techniques.

For livestock

- Commercial goat and sheep farming management.
- Fodder cultivation, pasture improvement, and silage making.
- Disease control, vaccination, and veterinary first-aid.

For green/NbS enterprises

- Nursery establishment and management.
- Bamboo and broom grass processing.
- Value chain development for MAPs and NTFPs.
- Business plan development for youth and women.

Support Required from NRCS, IFRC, WWF, and Local Government

The community expectations from key stakeholders include:

From NRCS & IFRC

- Support for climate-smart agricultural inputs and community-level water solutions.
- Demonstration plots for resilient crops and livestock.
- Strengthening community-based disaster preparedness groups.

From WWF

- Technical support for NbS interventions, forest restoration, riverbank stabilization.
- Biodiversity-friendly enterprise promotion (MAPs, beekeeping, nurseries).
- Ecosystem monitoring and watershed restoration.

From Local Government

- Support in accessing subsidized seeds, tools, and irrigation schemes.
- Linkage to local cooperatives and markets.
- Infrastructure investment (roads, storage facilities, water supply systems).
- Policy support for land-use planning and watershed protection.

Technologies and Infrastructure Needed

Several technologies were identified as essential to enable climate-smart livelihoods:

Water and Irrigation

- Solar-powered lift irrigation systems (high priority).
- Micro-irrigation kits (drip, sprinkler).
- Water harvesting ponds and tanks.
- Pipe systems for household and farm-level irrigation.

Agricultural Inputs and Equipment

- Low-cost greenhouses and tunnels.
- Village-level seed banks for resilient crops.
- Small tools for soil conservation (hoes, spades, hand tillers).

Livestock Support

- Fodder plantations, pasture development infrastructure.
- Improved sheds (storm-resistant, raised).
- Community veterinary services.

Processing & Storage

- Solar dryers for turmeric, ginger, and vegetables.
- Community storage units to reduce post-harvest losses.
- Small processing units for NTFP value addition.

Inclusion Needs for Women, Landless, and Marginalized Groups

Climate-smart livelihoods must be equitable and inclusive. Key inclusion dimensions include:

Women

- Prioritize women's groups for vegetable farming, beekeeping, poultry, MAP processing.
- Ensure access to microcredit without collateral.
- Provide literacy and business-management training.

Youth

- Engage youth in agroforestry, beekeeping, nursery establishment, nature based tourism.
- Training on digital marketing and enterprise management.

Marginalized and Land-Poor Households

- Promote homestead-based models:
 - kitchen gardening,
 - poultry,
 - spices and medicinal plants,

- beekeeping.
- Provide subsidized entry kits and group-based production models.

Dalit and Indigenous Groups

- Support enterprises linked to their traditional skills (e.g., bamboo crafts).
- Improve access to forest resources through equitable CFUG mechanisms.

iv. Summary of Climate-Smart Livelihood Pathways

Based on community consultations, the following sets of climate-smart livelihood pathways hold the strongest potential:

Climate-resilient crop diversification

Millet, pulses, turmeric, ginger, MAPs, and off-season vegetables.

Livestock intensification and diversification

Goats, improved poultry, beekeeping, and fodder-based livestock systems.

Nature-based and green enterprises

Nurseries, NTFP processing, broom grass, bamboo, eco-tourism, and riverbank plantation management.

Water-efficient agriculture

Solar pumps, drip irrigation, water harvesting systems.

Inclusion-focused livelihood models

Women-led enterprises, homestead production for the landless, and youth-led green jobs.

These climate-smart options, combined with targeted institutional support and investments, can significantly enhance community resilience and secure sustainable livelihoods in Mohanyal-5.

B. Midstream Areas of Kateni and Kandra River's Sub-watershed (Gauriganga Municipality– 7 & Ghodaghodi Municipality– 4 & 9)

Given the increasing frequency of climate variability and environmental stressors in midstream communities, the identification of climate-smart livelihood options is critical to enhance household income, resilience, and adaptive capacity. Discussions during FGDs, KIIs, and field observations highlighted both feasible livelihood options and required support mechanisms for promoting climate-resilient development.

i. Feasible Options Identified by Community

Crop-Based Options

- High potential crops under changing climate conditions include:
 - Paddy (short-duration varieties): Tolerant to irregular rainfall and short flood episodes.
 - Maize (drought-tolerant varieties): Suitable for mid-hills and lowland transition zones.
 - Vegetables: Tomato, chili, cucumber, cauliflower, bitter gourd—particularly for off-season cultivation using protective structures.
 - Legumes and oilseeds: Lentils, mustard, and soybeans for crop rotation and soil fertility improvement.
 - Fruits: Banana, guava, and papaya as supplemental income sources with potential for local markets.

Livestock Diversification

- Goat and sheep farming: Resilient to feed shortages and flexible in management; suitable for smallholders and landless households.
- Poultry: Improved breeds for meat and egg production, easily integrated with household income.
- Beekeeping: Provides additional income and supports pollination for crops and orchards.

Enterprises Thriving Despite Climate Risks

- Vegetable farming with protective structures (polyhouse, shade nets) for heat and flood mitigation.
- Aquaculture and small-scale fisheries in ponds and wetland areas; tolerant to water fluctuations with proper management.

- NTFP value addition: Processing broom grass, medicinal herbs, and mushroom cultivation for local markets.
- Goat/sheep fattening and small-scale dairy enterprises for resilient income streams.

Green Enterprises / NbS-Linked Income Activities

- Tree nurseries: Production of seedlings for riverbank plantation, community forests, and agroforestry.
- Riverbank plantation and bioengineering works: Income through labor for erosion control and flood mitigation.
- Wetland restoration and fishery management: Enhances ecosystem services and income generation.
- Eco-tourism and homestay services leveraging local wetlands, forests, and biodiversity (e.g., bird watching in Ghodaghodi wetlands).

ii. Required Support

Skills and Capacity-Building Needs

- Training on climate-smart agriculture (CSA), integrated pest management (IPM), organic farming, and water-efficient cultivation techniques.
- Skill development for livestock management, beekeeping, fisheries, and NTFP processing.
- Awareness and practical training on NbS-based ecosystem restoration and green enterprise management.
- Financial literacy and cooperative management for women, youth, and marginalized groups.

Support from NRCS, IFRC, WWF, and Local Governments

- Technical guidance for NbS-linked activities, agroforestry, and climate-resilient farming.
- Access to seedlings, improved crop varieties, livestock breeds, and beekeeping kits.
- Facilitation of market linkages, cooperatives, and green enterprise support programs.
- Assistance in establishing community-level irrigation and water management systems.

Technologies and Infrastructure Needed

- Irrigation systems: Small-scale canals, drip irrigation, and solar-powered water pumps.
- Storage facilities: Cold storage for vegetables, milk collection points, and seed banks.
- Protective structures: Polyhouses, shade nets, and livestock sheds to reduce climate exposure.
- Transportation support: Improved farm-to-market roads and access to collection centers.

Inclusion Needs

- Ensure women, youth, Dalit, landless, and marginalized groups have equitable access to training, credit, inputs, and market opportunities.
- Promote participation in decision-making for NbS and green enterprise initiatives.
- Encourage collective action through cooperatives and savings groups for inclusive livelihood enhancement.

C. Downstream Areas of Kateni and Kandra River's Sub-Watershed (Bhajani Municipality– 4 & Kailari Rural Municipality– 5)

The downstream communities of Bhajani Municipality- 4 and Kailari Rural Municipality- 5 face recurrent floods, riverbank erosion, waterlogging, and prolonged dry spells, which have severely affected traditional agriculture-based livelihoods. Despite these challenges, communities have identified several viable, climate-smart livelihood opportunities suitable for the changing climatic and ecological conditions of the sub-watershed. These options emphasize diversifying income sources, increasing resilience, and integrating ecosystem-based approaches that strengthen productivity while protecting local natural resources.

i. Feasible Climate-Smart Livelihood Options Identified by the Community

Climate-Resilient Crops and Crop Diversification

FGDs revealed a strong interest among farmers to shift toward crops that can tolerate floods, droughts, erratic rainfall, and pest outbreaks. The following crops were identified as promising:

Short-duration and flood-/drought-tolerant staples

- Short-duration paddy (e.g., Hardinath, Sawa Mansuli variants)
- Flood-tolerant paddy varieties in waterlogged pockets
- Drought-tolerant maize and millet in slightly elevated lands
- Pulses such as black gram, green gram, and lentils

These crop varieties reduce the risk of total crop failure and fit well into shortened or delayed monsoon cycles.

High-value vegetables

Vegetable farming is seen as one of the most reliable climate-smart options due to:

- Short cropping cycle
- Year-round production potential
- Strong market demand at Ghodaghodi, Attariya, Bhajani, and Dhangadhi markets

Promising crops include:

- Okra, brinjal, chili, cauliflower, cabbage
- Off-season cucurbits using low-cost poly tunnels
- Leafy greens for home consumption and local markets

Vegetables grown with mulching, drip irrigation, and organic manure have high resilience and profitability.

Oilseeds and cash crops

- Mustard
- Sesame
- Sunflower (as a pilot in elevated land)

These crops require less water, have stable market prices, and withstand moderate climate stress.

Potential for Livestock Diversification

Livestock rearing is a key livelihood activity, but climate change has increased disease prevalence, heat stress, and fodder scarcity. Communities identified the following opportunities:

Goat and sheep rearing

- High adaptability to climate stress
- Easy to sell during shocks
- Strong local and regional markets
- Potential for improved breeds and shed management

Poultry (local improved breeds)

- Short production cycle
- Growing demand for local chicken and eggs
- Lower feed cost when integrated with homestead farming

Dairy (small-scale improved cattle or buffalo)

Feasible only for households with better land access and fodder; however:

- Stall-feeding reduces grazing pressure on forests
- Encourages fodder tree plantation (agroforestry)

Integrated livestock–crop systems

- Poultry litter and cattle manure used for organic fertilizer
- Reduced input costs and improved soil health

Climate-Resilient and Nature-Based Enterprises

Given the frequent floods and erosion, the community sees strong potential for NbS-linked and environmentally adaptive livelihoods.

Fishery and Integrated Fish-Farming

Downstream areas with wetlands, oxbow lakes, ponds, and inundated lands provide opportunities for:

- Seasonal fish farming
- Floodplain aquaculture
- Integrated fish–vegetable systems
- Cage culture (pilots in controlled areas)

Fish farming is resilient to waterlogging and offers quick income returns.

Beekeeping (Apiculture)

Beekeeping is increasingly preferred due to:

- Low land requirement
- High climate resilience
- Value addition opportunities (honey, wax)
- Linkages with vegetable and fruit production (pollination benefits)

NTFP and forest-based enterprises

Communities identified potential in:

- Medicinal herbs (if supported by forest-user groups)
- Broom grass production and value addition
- Bamboo crafts and furniture
- Leaf-plate production (sal leaves), depending on access to CFUGs

Green enterprises as part of NbS

- Riverbank and embankment plantation maintenance
- Fodder and bamboo nursery operation
- Sale of seedlings for agroforestry and community plantations
- Community-based wetland management and eco-tourism (bird watching, guided visits)

These enterprises reinforce environmental conservation while generating income.

ii. Required Support for Enhancing Climate-Smart Livelihoods

While communities are motivated to adopt climate-smart and nature-based livelihood options, several enabling conditions are necessary for successful and sustained adoption.

Skills and Capacity-Building Needs

Communities expressed interest in targeted training on:

- Climate-smart agriculture (CSA) techniques
- Integrated Pest Management (IPM) and organic farming
- Improved livestock shed management and fodder development
- Nursery operation and agroforestry models

- Fishery techniques, including pond management and feed preparation
- Beekeeping and honey processing
- Post-harvest handling and storage for vegetables

Special focus is needed for women, youth, Dalit households, and land-limited families to ensure inclusive participation.

Institutional and Programmatic Support Required from NRCS, IFRC, WWF, and Local Governments

The communities highlighted specific support needs:

Expansion of NbS interventions

- Larger-scale riverbank stabilization using vetiver, bamboo, and native tree species
- Wetland restoration support to increase fishery potential
- Community-managed plantation areas for income diversification

Strengthening farmer groups and cooperatives

- Group-based production and marketing
- Access to financial literacy and savings programs
- Cooperative-level processing and storage infrastructure

Market linkage facilitation

- Engagement with buyers, traders, and cooperatives
- Contract farming possibilities for vegetables or livestock products

Technology and Infrastructure Requirements

The communities identified several critical technologies needed for building climate-resilient livelihoods:

- Small-scale irrigation systems (solar lift irrigation, drip systems)
- Water harvesting ponds to manage dry-season farming
- Low-cost poly tunnels for off-season vegetable production
- Solar pumps for irrigation and fish pond aeration
- Cold storage and collection centers to reduce post-harvest loss
- Livestock health services (vaccination, mobile vet clinics)
- Improved seeds and breeds suitable for climate stress

Infrastructure investments are essential to reduce climate losses and improve profitability.

Inclusion Needs of Women, Landless, Dalit, and Marginalized Groups

To ensure equity and social inclusion, the following measures are recommended:

- Prioritize households with limited land for small-scale enterprises (beekeeping, poultry, vegetable farming, fishery).
- Provide subsidized inputs (seeds, plastic tunnels, irrigation kits) for women and Dalit households.
- Facilitate access to credit through cooperatives with flexible repayment options.
- Ensure representation of women and marginalized groups in farmer groups, WUGs, CFUGs, and livelihood planning committees.
- Promote home-based and low-labor enterprises suitable for women with workload and mobility constraints.

VII. Gender Equality and Social Inclusion (GESI) Analysis

A. Upstream Areas of Kateni and Kandra River's Sub-watershed (Mohanyal RM, Ward No. 5)

Climate change impacts in Mohanyal Rural Municipality, Ward No. 5 are deeply intertwined with existing social structures, power relations, and livelihood roles. The upstream and sub-watershed settlements of Kateni and Kandra rivers comprised of smallholder farmers, Dalit households, Janajati/indigenous groups, women-headed households, and poor landholders reveal significant differentiated vulnerabilities and capacities. This section synthesizes findings from focus group discussions and household consultations, highlighting how gender and social inclusion dynamics shape exposure, sensitivity, and adaptive capacity in the watershed.

i. Gender Roles, Responsibilities, and Division of Labor

Agriculture and Livelihood Activities

Agricultural roles remain strongly gendered in Ward No. 5:

- Women carry primary responsibility for crop cultivation, seed selection, weeding, household kitchen gardening, small livestock rearing (goats, poultry), fodder collection, firewood collection, and water management.

- Men focus more on land preparation, cash crop marketing, large livestock (buffalo, bull) management, and off-farm income generation, especially seasonal migration to India.
- Youth especially young men are increasingly migrating for wage labor, leaving women with expanded agricultural and household burdens.

Climate-induced stresses (erratic rainfall, pest outbreaks, declining soil moisture) have increased women's time and labor burden, as they are responsible for collecting water, managing reduced yields, and seeking alternative food sources during shortages.

Decision-Making over Agricultural Resources

Decision-making authority is unequal:

- Men typically decide on crop choices, livestock sales, income use, and purchase of inputs.
- Women influence decisions related to kitchen gardens, small livestock, and household-level food management, but often lack authority for larger economic or farm investments.
- Dalit and land-poor households face additional constraints due to insecure land tenure and lower access to financial or extension services.

In several FGDs, women indicated that they perform most farm labor but have limited control over production decisions and income, reducing their ability to invest in climate-resilient options.

ii. Access to Services, Resources, and Opportunities

Access to Training, Extension Services, and Credit

There are clear disparities in access across gender, caste, and economic status:

- Women and Dalit households rarely receive agricultural training due to mobility restrictions, low confidence, limited notice, or events scheduled at inconvenient times.
- Youth and indigenous groups participate more actively in community meetings, but often lack access to formal credit or collateral.
- Most women rely on savings and credit groups rather than banking institutions.
- Extension services from the municipality or provincial line agencies are sporadic, and often reach better-connected or larger landholding farmers first.

This unequal access reduces the adaptive capacity of marginalized groups, limiting uptake of technologies such as drought-tolerant seeds, bio-fertilizers, improved goat sheds, or IPM practices.

Barriers to Participation

Key barriers identified during FGD include:

- Time burden from household care work, water collection, and agricultural labor.
- Cultural norms limiting women's mobility and voice in public forums.
- Lack of literacy among older women and Dalit community members, reducing participation in trainings.
- Economic hardships that prevent poorer families from attending training when it conflicts with daily wage labor.
- Language barriers for some indigenous women, limiting comprehension of technical training content.

Differentiated Impacts of Climate Change

Climate hazards affect social groups differently:

- Women experience heightened stress due to increased workload (fodder, water, fuelwood scarcity), reduced food availability, and responsibilities in caring for children, elderly, and sick family members during crises.
- Dalit and landless households living on marginal lands (steep slopes, near streambanks) are more exposed to landslides, soil erosion, and limited irrigation water.
- Indigenous households depending on forest products face constraints as forest availability declines due to erratic rainfall and forest degradation.
- Youth face shrinking local livelihood opportunities, increasing the trend of migration, which further burdens women.

Women reported that reduced agricultural productivity due to climate variability often leads to reduced food intake, impacting pregnant and lactating women disproportionately.

iii. Gendered and Socially Inclusive Adaptive Capacity

Despite constraints, there are existing strengths:

- Women's groups, mothers' groups, and community forestry groups provide platforms for collective action, mutual support, and small-scale savings.
- Dalit youth groups are engaged in small enterprises such as goat farming, vegetable nurseries, and wage labor diversification.
- Indigenous women possess traditional knowledge of *wild edibles, drought-tolerant crops, and forest-based coping strategies*, which are important for food security under climatic stress.

However, without targeted support, these capacities remain underutilized in climate-resilient planning.

iv. Key GESI Gaps Identified

- Limited women's leadership in water user groups, disaster management committees, and farmer groups.
- Unequal access to land, particularly for women and Dalits, limiting access to irrigation and credit.
- Low representation of marginalized households in market-oriented agriculture or value chains.
- Insufficient GESI-responsive budget allocation in municipal agriculture and climate programs.
- Climate adaptation programs rarely target women's time-saving technologies, such as water storage tanks, improved cookstoves, or fodder plantations.

B. Midstream Areas of Kateni and Kandra River's Sub-watershed (Gauriganga Municipality– 7 & Ghodaghodi Municipality– 4 & 9)

Gender and social dynamics play a critical role in shaping access to resources, decision-making, and resilience to climate risks in the midstream communities of the Kateni–Kandra sub-watersheds. Understanding GESI aspects is essential to ensure that livelihood interventions and NbS programs are inclusive, equitable, and effective.

i. Roles and Responsibilities

Gender Division of Labor

- Women: Primarily responsible for household management, water collection, kitchen gardening, tending small livestock (poultry, goats), fodder collection, and participation in NTFP collection. Women also assist in field activities such as transplanting paddy, weeding, and harvesting.

- Men: Mostly engaged in land preparation, plowing, irrigation maintenance, cash crop management, livestock grazing for large ruminants, and participation in wage labor or migration.
- Youth: Contribute to both farm labor and wage labor, often assisting men in heavier agricultural tasks or helping in irrigation and fishery activities.
- Marginalized groups (Dalit, landless): Work as agricultural laborers, participate in forest-based activities, or engage in daily wage labor; often performing labor-intensive tasks with limited control over resources.

Decision-Making

- Income and crop decisions: Predominantly made by male household heads, though women increasingly influence decisions on vegetable production, poultry, and small livestock.
- Livestock sales: Men typically make decisions on large ruminants (buffalo, cows), while women often manage sales of small livestock, eggs, and milk at local markets.
- Community participation: Men dominate leadership roles in local committees and cooperatives, whereas women's participation is limited due to social norms and household workload.

ii. Access to Services and Opportunities

Training, Credit, and Market Access

- Training: Access to agriculture, livestock, and NbS-related training is uneven. Women, youth, and marginalized groups often receive limited exposure due to cultural norms and mobility constraints.
- Credit: Cooperatives and microfinance institutions provide loans; however, collateral requirements, awareness gaps, and social barriers limit access for women, Dalit, and landless households.
- Markets: Women have access to local markets for small-scale produce (vegetables, eggs, milk), but limited mobility restricts participation in larger or distant markets.
- Extension services: Government and NGO extension support often prioritizes male heads of households; female farmers and marginalized groups have less frequent access to technical guidance and inputs.

Barriers to Participation

- Time constraints: Women carry dual responsibilities—household chores and farm-related work—which restricts participation in training and cooperative activities.
- Mobility: Cultural norms limit women’s movement outside the household or village, affecting attendance at workshops, markets, and community meetings.
- Workload: Heavy agricultural and household responsibilities reduce capacity for adopting new climate-smart practices.
- Social norms: Gendered expectations influence decision-making, access to resources, and recognition of contributions by women and marginalized groups.

iii. Differential Impacts of Climate Change

- Women: Face increased labor burdens during climate shocks, such as fetching water in dry seasons or securing fodder during droughts. Household food security and nutrition management largely depend on women, making them highly sensitive to climatic stress.
- Men: Experience income loss from failed cash crops or reduced livestock productivity, leading to increased migration and pressure to earn wages elsewhere.
- Youth: Vulnerable to employment loss and migration pressures; limited opportunities in climate-resilient sectors can exacerbate vulnerability.
- Marginalized groups (Dalit, landless, indigenous): Disproportionately affected by climate events due to limited land ownership, lack of financial safety nets, and weaker social networks. They often bear the brunt of labor-intensive recovery tasks and are more exposed to livelihood shocks.

C. Downstream Areas of Kateni and Kandra River’s Sub-Watershed (Bhajani Municipality– 4 & Kailari Rural Municipality– 5)

Gender equality and social inclusion (GESI) dimensions play a critical role in shaping livelihood resilience, climate vulnerability, and adaptive capacity in the downstream and sub-watershed communities of the Kateni and Kandra rivers. The socio-cultural context of Bhajani Municipality- 4 and Kailari Rural Municipality- 5 is characterized by diverse caste and ethnic groups—Tharu, Dalit, Madhesi, and migrant hill-origin households—each with differentiated access to resources, services, and decision-making spaces. Climate risks such as floods, riverbank erosion, drought, and declining agricultural productivity have disproportionate impacts on women, landless families,

Dalit communities, smallholders, and marginalized youth, further reinforcing existing inequalities.

This section synthesizes findings from FGDs, KIIs, and field observations on gender roles, access barriers, and disparities in climate change impacts and adaptive opportunities.

i. Gender Roles and Responsibilities

Division of Labor

FGD findings indicate a clear gendered division of roles in agriculture, livestock management, water collection, and household care:

- Women predominantly engage in:
 - Transplanting, weeding, harvesting, post-harvest cleaning
 - Daily livestock feeding, milking, shed cleaning
 - Collection of drinking water, fodder, and firewood
 - Household chores, child and elderly care
 - Assisting men in farm work but often without recognition as “farmers”
- Men mainly handle:
 - Ploughing, irrigation management, market sales
 - Purchase of seeds, fertilizers, and agri-inputs
 - Income-related decisions and cash crop farming
 - Migration for short-term labor work during income shortages
- Youth are increasingly involved in:
 - Seasonal migration (India, Gulf) due to limited local opportunities
 - Basic farm mechanization operations
 - Off-season vegetable production when supported by NGOs
- Dalit and landless groups act as:
 - Wage laborers during peak agricultural seasons
 - Tenants/sharecroppers with little asset control
 - Dependent on forest resources for firewood, fodder, and grazing

Decision-Making Patterns

Decision-making power is highly skewed:

- Men generally decide on:
 - Crop choices, livestock sale, and land use decisions
 - Borrowing loans or investing in agri-enterprises

- Use of income earned from farm production
- Women commonly decide on:
 - Daily household expenditures
 - Food distribution, small livestock care
 - Participation in savings groups

Only a minority of households (mainly those with male migration) show increased female decision authority, but structural barriers remain.

ii. Access to Services, Resources, and Opportunities

Access to Training and Extension Services

The study found unequal participation in capacity development:

- Women's participation in agricultural or climate-related trainings is restricted by:
 - Heavy domestic workload
 - Limited mobility due to cultural norms
 - Training venues located far from settlements
 - Limited female-friendly timing (usually during peak household activity hours)
- Dalit and indigenous Tharu groups reported:
 - Being informed late or not being informed at all
 - Feeling uncomfortable or unwelcome in mixed-group trainings
 - Language and confidence gaps in interacting with extension officials
- Youth (especially young women) expressed strong interest in:
 - Vegetable farming
 - Fishery
 - Digital agriculture information services

But lack financial and technical support to pursue these.

Access to Credit and Financial Services

Access to finance is uneven:

- Women participate actively in savings and credit groups, but:
 - Loan amounts are small
 - Interest rates can be high
 - They lack collateral (land ownership) to access formal bank loans
- Dalit households face:

- Discrimination in cooperative governance structures
 - Reluctance from lenders due to perceived “high risk”
- Youth entrepreneurs face difficulties due to:
 - No start-up capital
 - Requirement of land or property documents

Access to Markets

Women and marginalized groups experience barriers in reaching markets such as Bhajani bazaar, Attariya, or Godawari:

- Limited access to transportation
- Cultural norms restricting women from travelling alone
- Market information gaps
- Dependence on middlemen
- Limited bargaining power due to small production volumes

iii. Differential Impacts of Climate Change on Social Groups

Climate risks affect all groups, but impacts are uneven and socially mediated:

Women

- Increased workload due to:
 - Water scarcity → longer water-fetching time
 - Loss of forest resources → more time for fodder/firewood collection
 - Male migration → additional farm responsibilities
- Higher food insecurity during floods/drought as women generally eat last and least.
- Health risks from smoke due to reliance on firewood.

Dalit and Landless Households

- Highly exposed to flood and erosion as they often settle on low-lying or riverbank areas
- Lack of landownership prevents them from:
 - Accessing irrigation schemes
 - Receiving compensation/relief
 - Investing in improved livelihood options
- Dependence on daily wage labor makes them more vulnerable to climate-induced livelihood disruptions.

Indigenous Tharu Communities

- Loss of traditional fishing, forest resources, and wetland ecosystems threatens cultural and subsistence practices
- Degradation of river systems reduces fish catch and wetland-based livelihoods
- Climate change impacts undermine traditional knowledge systems

Youth

- Increasing out-migration due to declining productivity
- Reduced interest in farming unless modernized or commercialized
- High sensitivity to climate-induced job instability

iv. Barriers to Participation in Resilience and Livelihood Programs

The study identified several recurring barriers limiting GESI-sensitive participation:

- Time poverty among women
- Exclusion of Dalit groups in planning meetings
- Lack of representation of women and marginalized groups in CFUGs, WRMCs, and cooperatives
- Fear of public speaking and low confidence
- Institutional bias favoring economically stronger households
- Lack of female extension workers
- Limited climate information tailored for marginalized communities

4. Conclusion and Recommendation

4.1 Conclusion

The livelihood and climate risks assessment of the Katani and Kandra river sub-watershed of the Mohana river watershed, covering six wards across Mohanyal Rural Municipality, Ghodaghodi Municipality, Gauriganga Municipality, Bhajani Municipality, and Kailari Rural Municipality of Kailali district, reveals a high degree of interlinked climate, environmental, and socioeconomic vulnerability across the upstream, midstream, and downstream zones. The study confirms that climate-induced hazards particularly floods, riverbank erosion, droughts, erratic rainfall, heat stress, and ecosystem degradation are intensifying existing livelihood insecurities and social inequalities.

In the upstream areas (Mohanyal RM), deforestation, forest degradation, unplanned road construction, landslides, and declining spring sources have increased surface runoff and sedimentation. Livelihoods remain highly dependent on subsistence rainfed agriculture, forest resources, and seasonal wage labor, making households extremely sensitive to rainfall variability and climate shocks. Limited access to markets, extension services, irrigation, and alternative income opportunities further constrains adaptive capacity.

The midstream areas (Ghodaghodi and Gauriganga municipalities) experience compounded risks due to upstream land-use practices and localized pressures such as riverbank erosion, waterlogging, declining soil fertility, and unmanaged sand and gravel extraction. Although livelihood diversification is relatively higher compared to upstream, climate risks increasingly disrupt agriculture, fisheries, and small enterprises. Institutional coordination for watershed management remains weak, and existing coping strategies are largely reactive rather than planned.

The downstream areas (Bhajani and Kailari), located in the floodplain, are the most exposed to recurrent flooding, prolonged inundation, river course shifting, and loss of agricultural land and settlements. Communities here face chronic livelihood disruptions, food insecurity, asset loss, and health risks. Landlessness, tenancy, poverty, and social marginalization particularly among women-headed households, Dalits, landless households, and indigenous Tharu communities significantly reduce resilience and recovery capacity.

Across all zones, the study identifies critical gaps including:

- Limited integration of climate risk information into local development planning.

- Insufficient adoption of Nature-based Solutions (NbS) despite high ecological suitability.
- Weak institutional coordination across administrative boundaries within the watershed.
- Inadequate GESI mainstreaming in disaster risk reduction, livelihood programming, and natural resource governance.
- Over-reliance on short-term coping strategies such as migration, borrowing, and distress sale of assets.

Nevertheless, the assessment also highlights strong opportunities for building resilience through watershed-based planning, ecosystem restoration, climate-resilient livelihoods, and community-led NbS approaches. Traditional knowledge, community institutions, women's groups, forest user groups, and disaster management committees provide a solid foundation for scaling up integrated, inclusive, and sustainable interventions.

Overall, strengthening livelihood resilience in the Katani and Kandra sub-watershed requires a holistic upstream-midstream-downstream approach that simultaneously addresses ecological restoration, climate adaptation, livelihood diversification, social inclusion, and institutional capacity.

4.2 Recommendations

Based on the key findings and identified gaps, the following recommendations are proposed at strategic, thematic, and geographical levels:

4.2.1 Watershed-Level and Strategic Recommendations

- **Adopt Integrated Watershed Management Planning**
Local governments should jointly develop and implement an integrated watershed management plan for the Katani and Kandra sub-watershed, incorporating upstream–midstream–downstream linkages, climate risk scenarios, and ecosystem-based approaches in consultation with provincial Ministry of Industry, Forests and Environment.
- **Mainstream Climate Risk and NbS into Local Plans**
Climate risk assessment findings and NbS options should be systematically integrated into Local Disaster and Climate Resilience Plans (LDCRPs), annual plans, and medium-term expenditure frameworks of all five local governments.

- **Strengthen Inter-Municipal Coordination Mechanisms**

Establish or strengthen a sub-watershed coordination platform involving local governments, line agencies, community institutions, and development partners to ensure coherent planning, information sharing, and joint action.

4.2.2 Upstream-Specific Recommendations (Mohanyal Rural Municipality)

- **Ecosystem Restoration and Conservation**

- Promote reforestation, assisted natural regeneration, and slope stabilization using native species.
- Protect and recharge water sources through spring-shed management, recharge ponds, and vegetative barriers.

- **Climate-Resilient Agriculture and Livelihoods**

- Promote climate-resilient crops, agroforestry, soil conservation practices, and water-efficient farming techniques.
- Support livelihood diversification through value chain development of potential commodities such as horticulture (Orange, Lime, Kiwi), NTFPs (Timur, Tejpat, Chiuri, etc.), fodder tree plantation for goat farming, chicken rearing, nature based tourism like homestay, vocational and skill development training, input support, value addition, market linkages development.
- Provide training for Climate smart agriculture (CSA), integrated pest management (IPM), and organic manure preparation
- Support for soil nutrient management including soil testing to farmers before starting with the production/cultivation crops.
- Support for crop and livestock insurance.

- **Infrastructure and Risk Reduction**

- Apply climate-sensitive design in rural road construction to reduce landslide and erosion risks.
- Strengthen early warning systems and community-based disaster preparedness.

4.2.3 Midstream-Specific Recommendations (Ghodaghodi and Gauriganga Municipalities)

- Riverbank and Floodplain Management

- Implement bioengineering and NbS-based riverbank protection measures.
- Regulate sand, gravel, and stone extraction to reduce river degradation.
- **Livelihood Diversification and Market Access**
 - Promote climate-resilient fisheries, nursery development and plantation of fodder plant for goat farming, chicken rearing, buffalo farming, homestay promotion, mushroom farming, bee keeping, and NTFPs and horti/agri-business value chains development.
 - Provide training for Climate smart agriculture (CSA), integrated pest management (IPM), and organic manure preparation
 - Support for soil nutrient management including soil testing to farmers before starting with the production/cultivation crops.
 - Provide trainings and input support to the targeted beneficiaries on nursery, cultivation, harvesting, and post harvesting techniques of agro products before starting its cultivation
 - Support for crop and livestock insurance for minimizing risks of investment
 - Improve access to irrigation, storage, and markets to stabilize incomes.
- **Institutional Capacity Building**
 - Strengthen local institutions' capacity for climate-informed planning, monitoring, and enforcement of environmental regulations.

4.2.4 Downstream-Specific Recommendations (Bhajani and Kailari)

- **Flood Risk Reduction and Preparedness**
 - Scale up floodplain restoration, wetland conservation, and flood buffering NbS measures.
 - Strengthen early warning dissemination, evacuation planning, and flood-resilient infrastructure.
- **Resilient Livelihoods for Flood-Affected Communities**
 - Promote flood-tolerant crops, floating agriculture, fisheries, and off-farm income options.
 - Promote cultivation of Chaite Dhan (Paddy) through distributing improved seed;
 - Provide training for Climate smart agriculture (CSA), integrated pest management (IPM), and organic manure preparation

- Support for soil nutrient management including soil testing to farmers before starting with the production/cultivation crops.
 - Provide trainings and input support to the targeted beneficiaries on nursery, cultivation, harvesting, and post harvesting techniques of agro products before starting its cultivation
 - Promote organic farming of high value short rotation crops, off season vegetable farming, banana farming, riverbed farming including marketing and value chain development support
 - Support market led NTFPs based enterprise development focusing on production, value addition and marketing linkages development (Bamboo, Mentha, Chamomile, Citronella, Lemongrass, etc.)
 - Support crop and livestock insurance, access to microfinance, insurance, and social protection schemes.
- **Land and Settlement Planning**
 - Integrate risk-sensitive land-use planning to discourage settlement in high-risk zones.
 - Encourage voluntary relocation and safer housing options where risks are extreme.

4.2.5 Strengthen Market Linkages and Value Chain Development

- Conduct market mapping and value chain analysis for key local products (e.g., vegetables, honey, ginger, turmeric).
- Establish or strengthen producer groups and cooperatives to enable collective marketing, input purchase, and value addition.
- Facilitate market linkages with local traders, agro-vets, and cooperatives, and organize exposure visits and fairs.
- Promote digital and physical market information systems for price updates and buyer-seller coordination.

4.2.6 GESI and Social Inclusion Recommendations

- **Target Vulnerable and Marginalized Groups**
 - Design livelihood and resilience interventions that explicitly target women, Dalits, landless households, indigenous communities, elderly, and persons with disabilities.
- **Strengthen Women's Leadership and Agency**

- Enhance women's participation and leadership in watershed management, DRR committees, and livelihood groups.
- Provide targeted skills training, access to credit, and labor-saving technologies.
- **Ensure Inclusive Decision-Making**
 - Apply participatory planning approaches ensuring meaningful inclusion of marginalized voices in local planning and implementation.

4.2.7 Knowledge, Monitoring, and Learning

- **Strengthen Climate and Livelihood Monitoring**
 - Establish community-based monitoring systems to track climate impacts, ecosystem health, and livelihood outcomes.
- **Document and Scale Best Practices**
 - Document successful NbS and livelihood adaptation practices and promote cross-learning among wards and municipalities.
- **Leverage Partnerships**
 - Strengthen collaboration with provincial and federal agencies, NGOs, and development partners for technical support and resource mobilization.

Way Forward

The findings of this assessment provide a strong evidence base for designing and implementing integrated NbS-driven livelihood and climate resilience interventions in the Katani and Kandra sub-watershed. Translating these recommendations into action will require sustained political commitment, adequate financing, community ownership, and coordinated implementation across administrative boundaries. By adopting a holistic watershed approach that balances ecological integrity with inclusive livelihood development, the targeted local governments can significantly enhance resilience and ensure sustainable development outcomes for present and future generations.

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