

BASELINE ASSESSMENT REPORT

PRODUCTIVE AND SUSTAINABLE FOOD SYSTEMS IN BHUTAN FOR ENVIRONMENTAL BENEFITS AND GROSS NATIONAL HAPPINESS (FSP)

August, 2026

GEF Integrated Program (IP) Eastern Bhutan

23 Gewogs across Lhuentse, Mongar, Pemagatshel, Samdrup Jongkhar, Trashigang and Trashiyangtse

global environment facility
INVESTING IN OUR PLANET

Food and Agriculture Organization of the United Nations

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Acronyms

Acronym	Full Form
AFOLU	Agriculture Forestry and Other Land Use
AI	Artificial Insemination
ALOS PALSAR	Advanced Land Observing Satellite – Phased Array L-band Synthetic Aperture Radar
AMIS	Agricultural Marketing and Information System
asl	Above Sea Level
BBS	Bhutan Broadcasting Service
BFDA	Bhutan Food and Drug Authority
BLSS	Bhutan Living Standards Survey
BWS	Bumdeling Wildlife Sanctuary
CFG	Community Forest Group
CI	Core Indicator
CIFOR	Centre for International Forestry Research
CSA	Climate-Smart Agriculture
CSAI	Climate-Smart Agriculture Adoption Index
DEM	Digital Elevation Model
DoFPS	Department of Forest and Park Services
EA	Enumeration Area
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Safeguards
EX-ACT	Ex-Ante Carbon-balance Tool
FAO	Food and Agriculture Organization of the United Nations
FG	Farmer Group
FGD	Focus Group Discussion
FMCL	Farm Machinery Corporation Limited
FSIP	Food Systems Integrated Programme
FYP	Five-Year Plan
FYM	Farmyard Manure
GAP	Good Agriculture Practices
GAP	Gender Action Plan
GDP	Gross Domestic Product
GEB	Global Environmental Benefits
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIEWS	Global Information and Early Warning System

GIS	Geographic Information System
GLOF	Glacial Land Outburst Floods
GNH	Gross National Happiness
GPS	Global Positioning System
GRM	Grievance Redress Mechanism
ha	Hectare
HCRI	Household Crop Richness Index
HDDS	Household Dietary Diversity Score
HF	Holstein Friesian
HH	Households
HWC	Human-Wildlife Conflict
IALC	Integrated Agriculture and Livestock Census
IBA	Important Biodiversity Area
ICIMOD	International Centre for Integrated Mountain Development
ICRAF	International Centre for Research in Agroforestry
IFS	Integrated Farming System
ILM	Integrated Landscape Management
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
KAP	Knowledge, Attitudes and Practices
Kg	Kilogram
KII	Key Informant Interviews
KIL	Koufuku International Limited
JWS	Jomotshangkha Wildlife Sanctuary
LADA	Land Degradation Assessment in Drylands
LD	Land degradation
LDI	Land Degradation Index
LDN	Land Degradation Neutrality
LPG	Liquefied Petroleum Gas
LSMS	Living Standards Measurement Study
LULC	Land Use and Land Cover
M&E	Monitoring and Evaluation
MEAL	Monitoring, Evaluation, Accountability and Learning
MoAF	Ministry of Agriculture and Forests
MoAL	Ministry of Agriculture and Livestock
MoP	Muriate of Potash

MT	Metric Ton
MTR	Mid-Term Review
NAP	National Adaption Program
NbS	Nature-based Solutions
NCHM	National Center for Hydrology and Meteorology
NDC	Nationally Determined Contribution
NEXT	NDC Expert Tool
NFSPs	National Food Systems Pathways
NLCS	National Land Commission Secretariat
NSB	National Statistics Bureau
NTFP	Non-Timber Forest Product
PA	Protected Area
PHCB	Population and Housing Census of Bhutan
PIR	Project Implementation Review
PMU	Project Management Unit
PNP	Phrumsengla National Park
PRODOC	Project Document
RAMCO	Regional Agricultural Marketing and Cooperatives
RCI	Rangeland Condition Index
RGoB	Royal Government of Bhutan
RNR	Renewable Natural Resources
RUG	Road User Group
SEP	Stakeholder Engagement Plan
SLM	Sustainable Land Management
SOC	Soil Organic Carbon
SSP	Single Super Phosphate
SWS	Sakteng Wildlife Sanctuary
tCO_2e	Metric Tonnes of Carbon Dioxide Equivalent
TE	Terminal Evaluation
ToR	Terms of Reference
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
WOCAT	World Overview of Conservation Approaches and Technologies
WUA	Water User Association

Executive Summary

This report presents the baseline assessment for the GEF-8 project "Productive and Sustainable Food Systems in Bhutan for Environmental Benefits and Gross National Happiness" (FSIP, 2025–2030), implemented across 23 Gewogs in six eastern Dzongkhags—Lhuentse, Mongar, Pemagatshel, Samdrup Jongkhar, Trashigang, and Trashiyangtse. The assessment establishes verified reference values for project outcome indicators and relevant GEF Core Indicators (CI 3.1, CI 4.1, CI 4.3, and CI 6), replacing provisional design-stage estimates. The findings are based on a survey of 412 households across 187 villages, complemented by focus group discussions, key informant interviews and GIS analysis across the 1,136,102-ha project landscape.

The project landscape represents a unique mountain socio-ecological system where exceptional environmental assets coexist with significant agricultural and livelihood constraints. Forests dominate 891,476 hectares (79%) of the landscape, while cultivated land accounts for only 34,320 ha (3%). Approximately 1,034,714 ha (91%) qualify as natural habitat under GEF Core Indicator 4.1, highlighting the region's high biodiversity and ecosystem service values. However, limited agricultural land, steep terrain, fragmented holdings, and smallholder mixed crop–livestock systems constrain agricultural productivity and rural livelihood.

The surveyed population of 1,380 people lives in households averaging 3.6 (≈ 4) members. Female-headed households account for 44%, while 12% include persons with disabilities, emphasizing the importance of inclusive and gender-responsive approaches. Agricultural production is predominantly rainfed, with 47% of households having access to irrigation facilities. Although agriculture and livestock farming remain the primary income source for 58% of households, economic vulnerability is widespread, with 93% earning below Nu. 100,000 annually, including 63% stating no change in income over the past three years.

Environmental sustainability remains central to the project's rationale. Under GEF Core Indicator 4.3, 16% of households reported agricultural land degradation, primarily due to surface erosion (8%) and landslides (6%), resulting in a Land Degradation Index of 0.16. Sustainable Land Management (SLM) adoption remains limited, with 19% of surveyed households applying at least one SLM practice on a directly measured area of 13.4 ha and only 9% receiving formal SLM training. However, adoption potential is substantial, with 68% of households expressing interest in SLM practices, while 39% already apply agroforestry practices. Pastoral systems in the alpine Gewogs of Merak and Sakteng provide the baseline for GEF Core Indicator 3.1. Approximately 96% of households depend on community rangelands, covering 1,095 ha, with an overall Rangeland Condition Index of 0.56. Of assessed rangelands, 26% are classified as good, 56% moderate, and 15% degraded, with key pressures arising from overgrazing, shrub encroachment, changing transhumance patterns, and climate-related stress.

The landscape's ecological assets continue to support rural livelihoods and resilience. Approximately 92% of households live close to forests, benefiting from ecosystem services and forest resources. Agricultural biodiversity remains important, with households cultivating an average of 3 crop varieties (Crop Richness Index: 0.32) and 80% maintaining traditional or local varieties. These assets provide a foundation for resilient food systems, although increasing climate and socioeconomic pressures threaten their sustainability.

Climate-related risks are already affecting agriculture and livestock systems. Approximately 83% of households have experienced climate impacts, mainly from erratic rainfall (36%), pest and disease outbreaks (22%), and temperature variation (22%). Overall, 62% reported adverse effects on agricultural and livestock production.

Agricultural production remains predominantly smallholder-oriented, with limited productivity growth and market integration, although several commodities demonstrate commercial potential. Over the past three years, 87% of farmers reported stagnant or declining yields, while terrain constraints remain a major barrier to mechanization, with 29% identifying land unsuitability as the main constraint. Value-chain development remains limited, with only 25% of households engaged in value addition, 19% accessing processing facilities,

7% holding product certification, and 4% participating in exports. Nevertheless, potato, vegetables, dairy, and poultry demonstrate strong potential for commercialization and livelihood improvement, providing entry points for value-chain development under the project.

Food and nutrition security remain important concerns. While 65% of households maintain food self-sufficiency for seven months or longer, 35% experience seasonal food deficits. The average Household Dietary Diversity Score is four out of eight, indicating scope for greater dietary diversification through integrated and diversified production systems.

Women play a central role in agriculture, with 93% participating in farming activities, and demonstrate strong agency in both farm and household decision-making. Women are the sole decision makers more frequently than men in crop selection, land preparation and harvesting, input purchases, and household expenditure, while joint decision-making is common across most areas. Men have only a marginal lead in decisions on major farm investments. Despite their substantial contribution, women continue to face significant labour burdens, contributing approximately 22 hours per week to farm activities, while access to training remains limited, at 6% among women and 2% among youth.

Institutional support and extension services provide a sound platform for implementation, although stronger technical support, farmer organizations, market linkages, and value-chain infrastructure will be required to accelerate adoption and scale up sustainable practices.

Despite these challenges, the baseline demonstrates strong foundations for transformation. Approximately 70% of households are aware of sustainable agriculture practices, 65% are aware of climate-resilient practices, and 83% believe sustainable farming improves productivity and environmental outcomes. The average Climate-Smart Agriculture Adoption Index is 0.59 (approximately four of seven assessed practices), ranging from 0.53 in Trashigang to 0.82 in Lhuentse.

These finding indicate that the project is starting from a foundation of existing knowledge, practices and community institutions that can be strengthened through targeted technical support, improved access to services and inputs, market development, and investment in resilient production systems.

Overall, the baseline portrays a landscape of exceptional ecological importance facing interconnected challenges of land degradation, climate vulnerability, limited commercialization, and rural livelihood constraints. At the same time, strong agrobiodiversity, substantial forest and rangeland resources, community institutions, awareness of sustainable agriculture practices and farmers' willingness to adopt improved practices provide a solid foundation for project implementation. The baseline values established through this assessment provide a robust benchmark for measuring project performance, informing adaptive management, and assessing project impacts throughout implementation.

Strategic recommendations for project implementation focus on six interconnected priorities: restoring degraded landscapes through sustainable land management, agroforestry and ecosystem restoration; strengthening climate-resilient agricultural and livestock systems through improved production practices, water management and adaptive rangeland management; transforming smallholder farming into market-oriented enterprises by strengthening priority commodity value chains, value addition and market linkages; enhancing food and nutrition security through diversified and integrated production systems; strengthening inclusive institutions, farmer organisations, extension services and stakeholder coordination to ensure sustained adoption and long-term project impacts; and strengthening monitoring , evaluation and data management system to ensure reliable baseline-to-endline measurement, systematic learning and evidence-based adaptive management.

Together, these priorities provide a practical pathway for translating the project’s substantial environmental and social assets into more productive, sustainable and climate-resilient food systems while generating environmental benefits and contributing to Gross National Happiness.

1. Introduction

1.1 Background and Context

Bhutan's agri-food systems are central to national development, supporting food security, rural livelihoods, cultural identity, and environmental sustainability. Although agriculture contributes a modest share to the national economy, it remains the foundation of rural livelihoods, particularly in eastern Bhutan where most households depend on smallholder crop–livestock systems.

Bhutan is globally recognized for its commitment to environmental conservation and sustainable development. The constitution mandates maintaining at least 60% forest cover in perpetuity, and current forest coverage exceeds 70%. Forests, protected areas, and biological corridors provide essential ecosystem services, including watershed regulation, carbon storage, biodiversity conservation, and climate regulation. Bhutan is also part of the Eastern Himalaya Biodiversity Hotspot, one of the world's most ecologically significant regions.

Despite these achievements, agri-food systems face increasing pressures from climate change, land degradation, declining soil fertility, labour shortages, and changing market conditions. Climate variability has increased risks from erratic rainfall, drought periods, flash floods, landslides, and emerging pests and diseases. At the same time, rural outmigration, ageing farming populations, fragmented landholdings, limited mechanization, weak market linkages, and underdeveloped value chains constrain agricultural productivity and commercialization (Ministry of Agriculture and Livestock (MoAL) & Food and Agriculture Organization (FAO), 2025).

These challenges are particularly significant in eastern Bhutan, where rural communities depend closely on agriculture and natural resources within fragile mountain landscapes. The region encompasses diverse agricultural systems, forests, rangelands, and watersheds that support both livelihoods and ecosystem functions. However, difficult terrain, remoteness, infrastructure limitations, and exposure to environmental risks continue to affect production potential and livelihood resilience.

Recognizing these challenges, the Royal Government of Bhutan has prioritized agri-food systems transformation through the 13th Five-Year Plan (2024–2029) and National Food Systems Pathways. These frameworks emphasize food security, climate resilience, sustainable resource management, employment generation, and inclusive economic growth aligned with the principles of Gross National Happiness (GNH).

Within this policy context, the Global Environment Facility (GEF) supports the Productive and Sustainable Food Systems in Bhutan for Environmental Benefits and Gross National Happiness Project under the GEF-8 Food Systems Integrated Programme (FSIP). The project adopts an integrated landscape approach to address interconnected challenges in agriculture, livestock, biodiversity, land management, and markets while generating global environmental benefits.

1.2 Project Overview

The Productive and Sustainable Food Systems in Bhutan for Environmental Benefits and Gross National Happiness Project (FSIP–GEF-8) is jointly implemented by the Ministry of Agriculture and Livestock (MoAL) and the Food and Agriculture Organization of the United Nations (FAO), with financial support from the Global Environment Facility (GEF).

The project has a GEF grant of USD 9.585 million and co-financing of approximately USD 49.6 million, representing a total investment of more than USD 59 million (MoAL & FAO, 2025). It is implemented from 2025 to 2030 across 23 Gewogs in six eastern Dzongkhags: Lhuentse, Mongar, Pemagatshel, Samdrup Jongkhar, Trashigang, and Trashiyangtse.

The project landscape represents diverse agro-ecological and ecological systems, including agricultural areas, forests, rangelands, watersheds, protected areas, and biological corridors. The overall objective is to strengthen enabling conditions for sustainable food systems while ensuring environmental sustainability and delivery of Global Environmental Benefits (GEBs).

The project follows an Integrated Landscape Management (ILM) approach, recognizing the interdependence between agricultural production, ecosystem conservation, climate resilience, and rural livelihoods. It integrates climate-smart agriculture, sustainable land management, biodiversity conservation, sustainable rangeland management, nature-based solutions, and inclusive value-chain development.

Priority commodities include maize, buckwheat, quinoa, potato, vegetables (chilli, beans, tomato, broccoli, cauliflower, and asparagus), dairy, and poultry.

Project interventions are organized under three components:

1. *Component 1: Strengthening enabling environments*
    - Strengthening policies, institutional coordination, standards, certification systems, and investment frameworks to support sustainable food systems.
2. *Component 2: Transforming production systems*
    - Promoting climate-resilient agriculture, sustainable land management, ecosystem restoration, improved rangeland management, and sustainable value chains.
3. *Component 3: Knowledge management, innovation, monitoring, and learning*
    - Strengthening evidence generation, monitoring systems, knowledge sharing, innovation, and adaptive management.

1.3 Purpose and Objectives of the Baseline Survey

The baseline survey forms a critical component of the project's Monitoring, Evaluation, Accountability, and Learning (MEAL) framework. It establishes reliable reference information on environmental, socio-economic, institutional, and livelihood conditions at project inception.

During project preparation, several Results Framework indicators, including GEF Core Indicators, were estimated using secondary information or expert assumptions due to limited field-level evidence. The baseline survey provides empirical data to validate these estimates and establish measurable reference values for tracking project performance.

The baseline will support results-based management, Project Implementation Reviews (PIRs), Mid-Term Reviews (MTRs), Terminal Evaluations (TEs), and adaptive management. It will also provide evidence required for implementation of environmental and social safeguards, including the Environmental and Social Management Plan (ESMP), Stakeholder Engagement Plan (SEP), and Gender Action Plan (GAP).

Overall Objective

"To establish reliable and verifiable baseline conditions for all indicators in the project Results Framework."

Specific Objectives

The baseline survey aims to:

1. Establish baseline values for project output, outcome, and GEF Core Indicators.
2. Assess agricultural, livestock, environmental, and ecosystem conditions within project landscapes.
3. Analyse household livelihoods, food security, production systems, market participation, and resilience.
4. Generate gender-, youth-, and vulnerability-disaggregated information to support inclusive implementation.
5. Assess institutional capacity, governance systems, and access to extension and support services.
6. Establish baseline information for environmental and social safeguards and stakeholder engagement.
7. Identify key risks, constraints, opportunities, and enabling factors influencing project implementation.
8. Provide evidence to support adaptive management, learning, and future impact assessment.

Use of Baseline Findings

The baseline findings provide the reference point for measuring project progress and impact over time. They will be used to validate and update indicator baseline values, support realistic target setting, inform the prioritization of interventions across Gewogs, commodities, and beneficiary groups, guide resource allocation, establish environmental and social baseline conditions for ESMP implementation, and provide evidence for adaptive management during the Mid-Term Review (MTR) and Terminal Evaluation (TE).

The survey establishes baseline information for key GEF Core Indicators, including:

- CI 3.1: Rangelands under improved management
- CI 4.1: Landscapes under biodiversity conservation
- CI 4.3: Areas under sustainable land management
- CI 6: Greenhouse gas emissions reduced or avoided

1.4 Thematic Scope of the Study

The baseline survey covers all project intervention areas, thematic components, stakeholder groups, and indicators defined in the FSIP Results Framework.

The study focuses on five thematic areas:

1. Environmental and landscape systems
    - Land use, biodiversity, ecosystem services, land degradation, rangelands, climate risks, and sustainable land management practices.
2. Sustainable food systems and livelihoods
    - Crop and livestock systems, productivity, income sources, food security, market participation, and household resilience.
3. Institutional capacity and governance
    - Policies, institutional coordination, extension services, farmer groups, cooperatives, and local governance mechanisms.
4. Gender equality and social inclusion
    - Gender roles, decision-making, access to resources, youth participation, and barriers affecting vulnerable groups.
5. Environmental and social safeguards
    - Environmental sensitivities, social risks, stakeholder engagement, and safeguard requirements.

The study applies a mixed-methods approach combining household surveys, Focus Group Discussions (FGDs), Key Informant Interviews (KIIs), field observations, geospatial analysis, secondary data review, and stakeholder validation.

The resulting dataset provides the evidence base for monitoring project performance, assessing outcomes and impacts, supporting adaptive management, and strengthening accountability to national and international stakeholders.



Pics 1: Yangneer, Trashigang



Pics 2: Dawzor, Khaling (Trashigang)

2. Project Area Profile

2.1 Geographic Location and Administrative Coverage

The Productive and Sustainable Food Systems in Bhutan for Environmental Benefits and Gross National Happiness (FSIP–GEF-8) Project is implemented across 23 Gewogs in six eastern Dzongkhags: Lhuentse, Mongar, Pemagatshel, Samdrup Jongkhar, Trashigang, and Trashiyangtse (**Table 2.1; Figure 2.1**).

The project area represents a diverse mountain landscape extending from subtropical foothills in the south to alpine environments in the northern highlands. The landscape comprises agricultural areas, forests, rangelands, watersheds, protected areas, and biological corridors, reflecting the ecological diversity and varied livelihood systems of eastern Bhutan (MoAL & FAO, 2025).

The region is characterized by steep terrain, deep river valleys, dispersed settlements, and varying levels of accessibility. These geographical features influence settlement patterns, land-use systems, agricultural practices, and access to infrastructure and services. Rural communities are primarily located along valleys, mid-altitude slopes, and upland areas where farming is integrated with livestock production and natural resource use.

The six project Dzongkhags comprise approximately 170,304 people living in 37,392 households, with about 23,514 ha classified as agricultural land and approximately 15,284 ha under cultivation (MoAL & FAO, 2025). Agriculture remains the dominant livelihood activity, with smallholder mixed crop–livestock systems forming the foundation of rural livelihoods.

The project landscape provides a diverse setting for assessing agricultural production systems, household livelihoods, environmental conditions, and adoption of sustainable practices. The baseline assessment considers these geographical and socio-economic variations when interpreting differences among Gewogs and farming communities.

Table 2.1: Overview of the FSIP Project Area

Indicator	Description	Source
Project Dzongkhags	6 (Lhuentse, Mongar, Pemagatshel, Samdrup Jongkhar, Trashigang and Trashiyangtse)	FSIP PRODOC (2025)
Project Gewogs	23	FSIP PRODOC (2025)
Survey households	412 HH	Baseline Survey (2026)
Survey villages	187 villages	Baseline Survey (2026)
Estimated population	170,304 persons	PHCB (2017); Dzongkhag Statistical Yearbooks
Estimated households	37,392 HH	PHCB (2017)
Agricultural land	Approximately 23,514 ha	FSIP PRODOC (2025)
Cultivated land	Approximately 15,284 ha	FSIP PRODOC (2025)
Elevation range	Approximately 200–5,800 m above sea level	FSIP PRODOC (2025)
Dominant farming system	Smallholder mixed crop–livestock farming	FSIP PRODOC (2025); MoAL RNR Statistics
Major commodities	Maize, potato, vegetables, buckwheat, dairy and poultry	IALC (2025); MoAL RNR Statistics
Key environmental assets	Eastern Himalaya Biodiversity Hotspot, protected areas and biological corridors	FSIP PRODOC (2025)

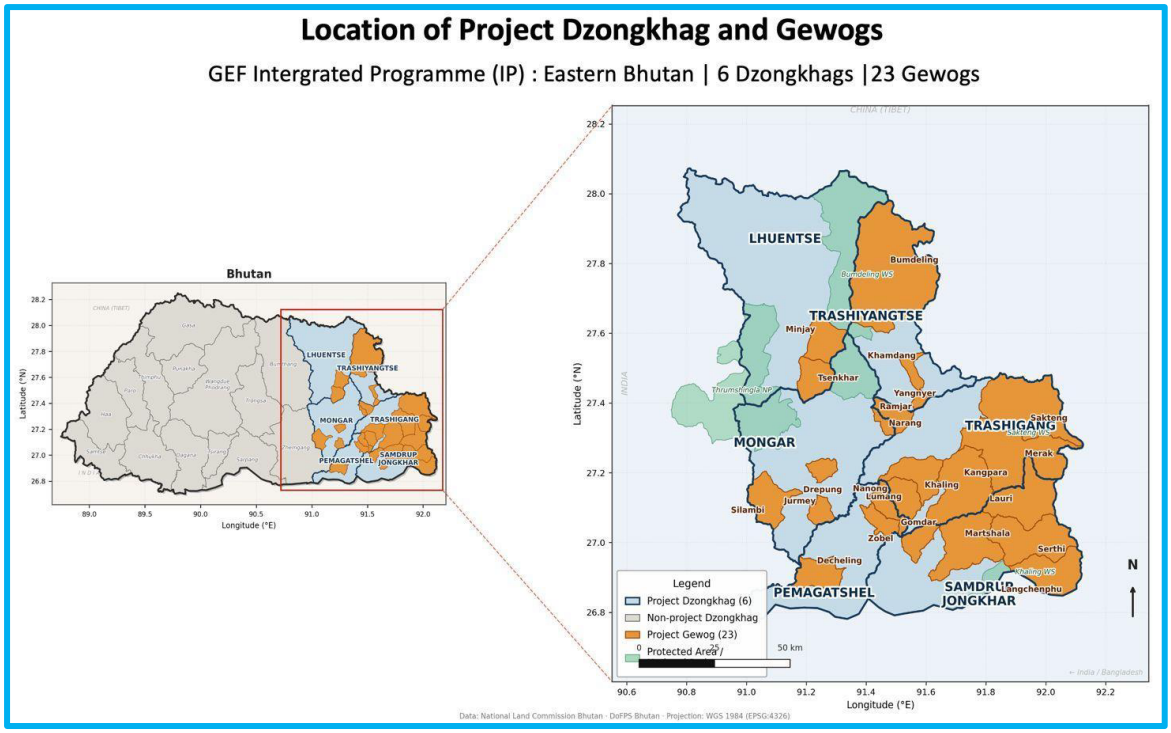


Figure 2.1: Location of Project Dzongkhags and Gewogs in 6 Eastern Dzongkhags

2.2 Agro-Ecological and Climatic Conditions

The FSIP project area encompasses a wide range of agro-ecological environments, extending from warm subtropical areas to alpine ecosystems. Elevation ranges from approximately 200 m to over 5,800 m above sea level, resulting in substantial variation in climate, vegetation, farming systems, and livelihood practices across the six Dzongkhags (MoAL & FAO, 2025).

The diversity of agro-ecological conditions supports a range of crop and livestock production systems. Lower elevations are suitable for rice, maize, vegetables, fruits, and mixed livestock systems, while cooler mid- and high-altitude areas support potato, buckwheat, temperate vegetables, cattle, and yak-based production systems.

The major farming systems across the project area include:

- **Rice-based systems** in irrigated valley areas;
- **Maize-based rainfed systems** across mid-altitude landscapes;
- **Potato and temperate vegetable systems** in cooler production zones;
- **Buckwheat and other high-altitude crops** contributing to local food systems; and
- **Cattle and yak-based livestock systems**, particularly in high-altitude areas such as Merak, Sakteng, and northern Lhuentse (NSB, 2025).

Agricultural systems are predominantly smallholder-based and vary according to altitude, climate, land availability, irrigation access, and market connectivity. These differences create distinct production environments across Gewogs and influence household choices regarding crops, livestock, and farming practices.

Table 2.2: Agro-ecological characteristics of six FSIP Dzongkhags

Parameter	Lhuentse	Mongar	Trashigang	Trashiyangtse	Pemagatshel	Samdrup Jongkhar
Agro-ecological range	Subtropical to alpine	Subtropical to cool temperate	Subtropical to alpine	Subtropical to alpine	Subtropical to warm temperate	Subtropical to lower temperate
Dominant crops	Maize, rice, buckwheat, vegetables	Rice, maize, vegetables	Rice, maize, buckwheat	Rice, maize, buckwheat	Maize, rice, horticulture	Rice, maize, vegetables, fruits
Dominant cropping systems	Maize, rice, buckwheat, vegetables	Rice, maize, vegetables, citrus	Rice, maize, buckwheat	Rice, maize, buckwheat	Maize, rice, millet, horticulture	Rice, maize, vegetables, fruits
Livestock systems	Cattle and yak systems	Mixed cattle systems	Cattle and yak systems	Mixed cattle systems	Cattle and mixed livestock	Cattle, poultry, pigs
Farming environment	Mostly rainfed with localized irrigation	Predominantly rainfed	Predominantly rainfed	Predominantly rainfed	Rainfed dominant	Irrigated lowlands and rainfed uplands

Source: Adapted from FSIP PRODOC (2025), MoAL agro-ecological information, and Dzongkhag planning documents.

2.3 Socio-economic Profile

The socio-economic characteristics of the FSIP project area are shaped by its predominantly rural population, dependence on agriculture and livestock-based farming system and natural resources, mountainous terrain, and varying access to infrastructure and services.

The six project Dzongkhags have an overall estimated population of 170,304 people living in 37,392 households (NSB, 2017a). Population distribution varies considerably, with larger settlements concentrated in accessible valleys and road-connected areas, while remote upland communities remain sparsely populated due to difficult terrain and limited livelihood opportunities.

Rural livelihoods are primarily based on smallholder crop and livestock production, complemented by wage employment, business activities, government services, and remittances. While agriculture remains central to household food security and income generation, increasing livelihood diversification has changed the role of farming within rural households.

Access to infrastructure and services varies across the project landscape. Communities in remote areas generally experience greater challenges related to transportation, access to agricultural inputs, extension services, markets, and other support services due to geographical constraints and dispersed settlement patterns.

Changing demographic patterns, including rural outmigration, youth migration, and an ageing farming population, influence household labour availability and farming practices. These changes are particularly relevant for labour-intensive crop and livestock activities.

Despite these variations, the project area provides significant opportunities for strengthening sustainable agricultural production systems through improved productivity, diversified livelihoods, and enhanced integration of crop, livestock, and natural resource management. The baseline assessment uses this socio-economic context to interpret household-level findings on production systems, livelihoods, resource use, and adoption of sustainable practices.

3. Literature Review

The literature review was conducted to inform, contextualize, and triangulate the findings from the primary data collection. The review drew upon secondary sources of information, including published papers related to agriculture and livestock, government reports, policy documents, data and other relevant official publications.

The review is organized thematically as follows:

- Policy and project document context, including a review of relevant policies, Productive and Sustainable Food Systems Project's monitoring and evaluation framework, core indicators, and key assumptions and risks
- Agriculture and food systems covering structural characteristics, production trends, agricultural systems in the six eastern Dzongkhags, production dynamics, constraints, and existing interventions;
- Land degradation and sustainable land management practices, including assessments of land degradation, soil erosion, watersheds, sustainable land management programmes, and agroforestry;
- Rangeland management, including rangeland extent, grazing systems, pasture productivity, overgrazing, livestock carrying capacity, and community grazing management;
- Biodiversity and ecosystem services covering protected areas, biological corridors, species richness, agro-biodiversity, pollinators, and human-wildlife conflict;
- Climate change and environmental risks including temperature trends, rainfall variability, drought frequency, flood risks, landslides, and extreme weather events
- Gender equality and social inclusion, covering gender roles, women's access to resources, youth participation, labour burdens, access to extension services, and vulnerable households; and
- Institutional capacity and governance, including extension systems, farmer groups, cooperatives, producer organizations, community institutions, and local governance mechanisms.

3.1 Policy, Strategic and Institutional Context

The policy and institutional context for this baseline assessment is drawn from national strategies, policy briefs, and project documents related to agriculture, livestock, food systems, and rural development.

3.1.1 Policy Review

Bhutan's agricultural development is guided by national priorities anchored in food and nutrition security, rural livelihoods improvement, agricultural commercialization, and sustainable natural resources management, and the principles of Gross National Happiness (GNH). The 13th Five Year Plan (2024–2029) prioritizes increased domestic food production, productivity, value chains development, market access, climate-resilient agriculture, and greater private-sector participation (MoAL, 2024). These are complemented by the Bhutan Agri-food Sector Strategy 2034, Food and Nutrition Security Policy 2023, Bhutan National Pathways: Food Systems for GNH Pathways 2021, Cost Sharing Mechanism Guidelines 2025, and the Farm Mechanization Policy Framework, which collectively promote irrigation expansion, biodiversity conservation, commercialization, digital agriculture, research and innovation, agricultural insurance, sustainable mechanization, and inclusive support for women, youth, and cooperatives (MoAL, n.d.; MoAL, 2023; MoAL, 2025; MoAF, 2021; MoAF, 2022).

The agri-food sector contributes about 14.67% of GDP and employs 43.5% of the national workforce, remaining central to rural livelihoods despite declining agricultural labour due to rural–urban migration, youth outmigration, and an ageing farming population (MoAL, n.d.; MoAL, 2023). Key constraints include declining cultivated land, limited irrigation, fragmented landholdings, low mechanization, labour shortages, weak market infrastructure, limited access to finance and technology, substantial post-harvest losses, human–wildlife conflict, and increasing climate-related risks. Bhutan also faces a widening agricultural trade deficit, high food import dependence, and persistent food and nutrition challenges (MoAL, n.d.; MoAL, 2021; MoAL, 2023; MoAL, 2025; MoAF, 2022).

Priority intervention areas include irrigation expansion, improved seed and breed systems, mechanization, post-harvest and cold-chain infrastructure, climate-smart agriculture, sustainable land management, livestock improvement, extension services, market linkages, access to finance and agricultural insurance, and institutional strengthening. Development partners, including FAO, support these efforts through programmes

on climate adaptation, biodiversity conservation, watershed management, food system transformation, and market development.

The FSIP–GEF-8 Project is well aligned with these national priorities through an integrated landscape approach combining sustainable production, biodiversity conservation, climate resilience, value-chain development, and institutional strengthening. The baseline assessment provides the empirical evidence needed to establish benchmark indicators, identify production and livelihood constraints, and inform implementation, monitoring, and evaluation.

3.1.2 Review of Project Results Framework and Core Indicators

The project adopts a comprehensive Results and Monitoring Framework aligned with its Theory of Change and the GEF Core Indicators. It aims to increase the adoption of sustainable agricultural practices, improve agricultural productivity and profitability, strengthen climate and environmental resilience enhance food and nutrition security, improve ecosystem health, and increase HH incomes while generating global environmental benefits through reduced land degradation, biodiversity conservation, sustainable land management, and enhanced ecosystem services.

The project emphasizes inclusiveness, targeting women, youth, smallholders, producer groups, and vulnerable HH. Its Theory of Change assumes that strengthened institutional capacity, improved access to sustainable technologies and productive assets, enhanced market opportunities, and coordinated governance will enable farming HH to adopt more productive and environmentally sustainable practices, contributing to improved livelihoods, food and nutrition security, climate resilience, and landscape restoration.

The M&E framework relies on administrative records, GIS-based monitoring, and project information systems. However, national datasets provide limited HH-level evidence on production systems, technology adoption, commercialization, climate resilience, sustainable land management, and livelihood outcomes within the project areas. The baseline survey addresses these knowledge gaps through an integrated assessment of HH surveys, FGD, KIIs, and secondary data analysis. It establishes benchmark values for key indicators, validates the project's Results Framework, provides contextual and qualitative evidence, assesses institutional capacity, and verifies the assumptions underpinning the Theory of Change. Findings will support target setting, adaptive management, and future midline and endline evaluations.

While the Results Framework aligns with GEF reporting requirements, refinements would strengthen monitoring: clearer indicator definitions and attribution pathways for landscape restoration, biodiversity conservation; updated land-use and land-cover baseline ; strengthened verification for capacity-building and sustainable land management adoption; greater transparency in greenhouse gas (GHG) mitigation estimates ; review of overlapping indicators; and robust co-financing tracking mechanisms.

Key assumptions underpinning success include effective cross-sectoral coordination, widespread adoption of nature-based and climate-resilient practices supported by viable value chains and incentives, continued knowledge sharing and innovation uptake, and the long-term viability of climate-resilient technologies under changing climatic conditions.

The overall project risk rating is moderate, with key risks including climate-related hazards, environmental and social impacts, institutional capacity constraints, and coordination challenges. Mitigation measures include climate-resilient project design, Environmental and Social Management Plan(ESMP) implementation, capacity building, inclusive stakeholder engagement, and Project Steering Committee oversight. Political, institutional, technological, financial, and fiduciary risks are assessed as low due to strong government ownership, established implementation systems, and supportive policy frameworks.

3.2 Agriculture and Food Systems

3.2.1 Overview of Agriculture and Food Systems in Eastern Bhutan

Agriculture remains a critical component of rural livelihoods and food systems in eastern Bhutan; however, the sector is undergoing a gradual transformation from predominantly subsistence-oriented production toward more diversified and market-responsive systems. Historically, smallholder farming systems have been centred on household food production, integrating crop cultivation, livestock rearing, and management of local natural

resources. These integrated systems have contributed to food security, nutrient cycling, risk buffering, and livelihood resilience, particularly in remote mountain environments.

However, the productivity and economic viability of these systems are increasingly challenged by structural changes affecting rural agriculture. Fragmented landholdings, limited mechanization, declining household labour availability, dependence on rainfall, and restricted access to quality inputs and services constrain productivity improvements and limit the ability of farmers to respond to emerging market opportunities (MoAL, 2025; NSB, 2025).

At the same time, eastern Bhutan is experiencing a gradual shift toward diversified agricultural enterprises driven by improved road connectivity, increasing domestic demand, government support programmes, and the emergence of farmer groups and cooperatives. Commercial production of high-value commodities, including vegetables, potato, dairy, poultry, and emerging crops such as quinoa, provides opportunities for increasing farm income and strengthening rural livelihoods. Nevertheless, commercialization remains uneven, as production systems in remote areas continue to face challenges related to scale of production, market access, post-harvest management, and service delivery.

The transition from subsistence to commercially oriented agriculture therefore requires more than increased production. It depends on strengthening the entire food system, including input supply, production technologies, aggregation, processing, market institutions, and access to knowledge and finance.

Table 3.1: Characteristics of agriculture and food systems in eastern Bhutan

Dimension	Key Characteristics	Implications
Agro-ecological setting	Diverse landscapes ranging from subtropical lowlands to high-altitude areas, supporting varied crop and livestock systems	Enables production diversification but requires location-specific approaches
Farming systems	Predominantly smallholder mixed crop–livestock systems integrating crops, livestock, and natural resources	Supports food security, income diversification, and household resilience
Major commodities	Maize, rice, buckwheat, potato, vegetables, quinoa, dairy, cattle, yak, and poultry	Provides opportunities for diversification, nutrition, and commercialization
Production characteristics	Mainly rainfed, fragmented, and labour-intensive farming in mountainous terrain	Increases vulnerability to climate risks, labour shortages, and limited mechanization
Emerging opportunities	Growing demand for high-value crops, livestock products, value addition, and improved market linkages	Creates pathways for resilient and market-oriented agriculture
Key constraints	Climate variability, land degradation, limited inputs and services, weak market systems, and post-harvest challenges	Limits productivity, profitability, and sustainable food system transformation

(Sources: FSIP PRODOC (2025); NSB IALC (2025); MoAL (2025))

3.2.2 Priority Commodity Systems and Commercialization Potential

The FSIP priority commodities represent different stages of agricultural transformation, ranging from traditional food-security crops to emerging commercial enterprises. Their development potential depends on their contribution to household livelihoods, production feasibility, market demand, and compatibility with sustainable production systems.

Maize remains strategically important because of its dual role in household consumption and livestock feed systems. Despite being widely cultivated, productivity gains remain constrained by labour shortages, wildlife damage, limited mechanization, and variable access to improved production technologies. Enhancing maize

productivity will require improved agronomic practices, appropriate mechanization options, and integration with livestock-based value chains.

Potato and vegetables represent stronger commercialization pathways due to established market demand and higher income potential compared with traditional cereals. However, evidence indicates that commercialization of these commodities is affected by weaknesses across the value chain, including unreliable access to quality seed and planting materials, production risks, inadequate storage, post-harvest losses, and price instability. Strengthening market coordination, producer organizations, and post-harvest systems is therefore critical for improving profitability.

Buckwheat occupies an important niche due to its cultural value, nutritional benefits, and suitability to marginal environments. However, declining economic incentives have reduced its competitiveness compared with alternative crops. Market development, product diversification, and value addition could improve its contribution to local food systems and agro-biodiversity conservation.

Quinoa represents an emerging opportunity for crop diversification and climate-resilient production. However, its expansion remains constrained by limited farmer experience, weak seed systems, inadequate processing facilities, and uncertain markets. Successful promotion requires coordinated development of production technologies, market demand, and value-chain support.

Dairy and poultry systems provide important pathways for income diversification and improved household nutrition. Dairy development has benefited from improvements in breeding services, veterinary support, milk collection systems, and farmer organizations. However, productivity remains below potential due to feed limitations, animal health constraints, management gaps, and limited processing capacity. Similarly, poultry production has market potential but requires stronger support in biosecurity, feed supply, and technical management.

Overall, commodity development in eastern Bhutan requires differentiated strategies. Food-security crops require productivity enhancement and resilience improvement, while commercial commodities require stronger value-chain integration and market systems.

3.2.3 Key Challenges and Opportunities for Sustainable Food Systems

The challenges facing agriculture in eastern Bhutan are interconnected and reflect broader constraints within mountain food systems.

Production constraints: Agricultural productivity is affected by limited access to improved inputs, inadequate technical support, low mechanization levels, and continued dependence on labour-intensive farming practices. These constraints are particularly significant for crops and livestock enterprises requiring timely management and higher production intensity.

Labour and demographic changes: Rural outmigration, youth disengagement, and ageing farming populations are reshaping household production capacity. Labour shortages increasingly influence crop choices, livestock management decisions, and adoption of labour-saving technologies. Addressing these trends requires greater investment in mechanization, skills development, and attractive opportunities for youth engagement.

Climate and resource pressures: Mountain farming systems are highly sensitive to climatic variability and environmental changes. Rainfed production systems, particularly maize, potato, and vegetables, face increased uncertainty due to changing rainfall patterns, extreme weather events, and resource degradation. Strengthening climate-smart agriculture and sustainable land management approaches is therefore essential for maintaining long-term productivity.

Market and value-chain limitations: While market opportunities are expanding, many farmers remain constrained by fragmented production, limited aggregation, weak storage and processing facilities, and high transportation costs. Strengthening farmer organizations, market information systems, value addition, and private-sector engagement will be important for improving commercialization outcomes.

Despite these challenges, eastern Bhutan has considerable potential for sustainable food system transformation. Increasing domestic demand, improved connectivity, government investment, farmer

organizations, and growing interest in environmentally sustainable production provide opportunities to develop more resilient and market-oriented agricultural systems.

3.2.4 Implications for the FSIP Baseline Assessment

The literature indicates that agricultural transformation in eastern Bhutan requires simultaneous improvements in productivity, resilience, sustainability, and market integration. However, existing evidence provides limited household-level information on production practices, technology adoption, commercialization pathways, climate resilience, and livelihood outcomes.

The FSIP baseline assessment addresses these knowledge gaps by establishing empirical evidence on farming systems, priority commodity performance, access to agricultural services, adoption of climate-smart agriculture and sustainable land management practices, value-chain participation, and household livelihood conditions.

The baseline findings will provide the reference point for measuring changes in agricultural productivity, sustainability, resilience, and livelihood outcomes, while supporting adaptive management and prioritization of FSIP interventions.

3.3 Land Degradation and Sustainable Land Management

Land degradation is a major challenge in mountain agricultural systems, where steep terrain, intense monsoon rainfall, fragile soils, and increasing land-use pressures contribute to soil erosion, declining soil fertility, and reduced land productivity. In Bhutan, these challenges are particularly significant due to the country's mountainous landscape, where agricultural activities are concentrated on vulnerable slopes. Bhutan's commitment to achieving Land Degradation Neutrality (LDN) by 2030 under the United Nations Convention to Combat Desertification (UNCCD) highlights the importance of establishing reliable baseline information on land condition, degradation trends, and restoration efforts (UNCCD, 2017; Cowie et al., 2018).

Studies across the Hindu Kush Himalayan region indicate that land degradation is spatially variable and influenced by agricultural expansion, infrastructure development, changing land-use patterns, and climate variability. In Bhutan, degradation processes commonly include soil erosion, declining soil organic matter, landslides, and loss of productive capacity, particularly in cultivated areas located on steep slopes. Remote sensing assessments and regional studies have identified localized degradation hotspots associated with intensive cultivation, road development, inadequate drainage, and reduced maintenance of traditional land management systems (ICIMOD, 2020).

In eastern Bhutan, the dominant land degradation processes affecting agricultural landscapes include sheet erosion, rill and gully formation, soil nutrient depletion, and slope instability. These processes are intensified by heavy monsoon rainfall, cultivation on marginal slopes, and limited adoption of soil conservation measures. Landslides and erosion events not only reduce agricultural productivity but also affect rural infrastructure, market access, and household resilience.

Sustainable Land Management (SLM) provides an integrated approach to addressing these challenges by maintaining land productivity while conserving ecosystem functions. These approaches complement climate-smart agriculture practices by improving soil health, reducing production risks, and enhancing farm resilience. Relevant SLM practices for Bhutan include contour farming, stone bunds and terraces, contour hedgerows, agroforestry, improved soil fertility management, conservation agriculture, and water management practices (WOCAT, 2017; FAO, 2015a). Traditional terrace systems and indigenous land management practices have historically contributed to soil conservation; however, declining rural labour availability and changing livelihood patterns have affected their maintenance in many areas.

Despite increasing recognition of the importance of SLM, information on household-level adoption, spatial distribution, and effectiveness of conservation practices remains limited in eastern Bhutan. Farm-level data on soil health, soil organic carbon, erosion status, and land management practices are also limited, restricting evidence-based targeting of restoration and resilience interventions.

3.4 Rangeland Management

Rangelands (tsamdro) are an important component of Bhutan's mountain farming systems, supporting livestock production, household livelihoods, and ecosystem services, particularly in areas where cattle, dairy, and yak-based systems contribute significantly to household livelihoods (Namgay et al., 2013). However, rangeland productivity and accessibility have declined due to changing land-use patterns, reduced transhumance, climate variability, shrub encroachment, and declining traditional pasture management practices. These changes have contributed to forage shortages and reduced livestock productivity in many pastoral communities (Dorji et al., 2020; Namgay et al., 2021; Tsheten et al., 2023).

Traditional grazing systems enabled sustainable seasonal use of pasture resources; however, labour shortages, rural outmigration, and changing livelihood preferences have contributed to a gradual shift toward more sedentary livestock production. This has increased pressure on available grazing resources and highlights the need for improved pasture management, forage development, and climate-resilient livestock practices (Wangdi & Wangchuk, 2017).

Strengthening rangeland sustainability requires improved grazing management, restoration of degraded pastures, integration of local knowledge, and stronger community-based governance systems. Given the importance of livestock for rural livelihoods in eastern Bhutan, the FSIP baseline assessment examines livestock systems, forage availability, grazing practices, and related production constraints to establish evidence for sustainable livestock and rangeland management interventions.

3.5 Biodiversity and Ecosystem Services

Bhutan is part of the Eastern Himalaya Biodiversity Hotspot and supports globally significant biodiversity through extensive forest cover, protected areas, and biological corridors. The six FSIP target Dzongkhags i.e., Lhuentse, Mongar, Pemagatshel, Samdrup Jongkhar, Trashigang, and Trashiyangtse form part of this interconnected landscape where agricultural systems, forests, and rangelands interact to support rural livelihoods and ecosystem functions (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), 2019; FAO, 2011).

Eastern Bhutan's agricultural landscapes are characterized by diverse smallholder systems integrating crops, livestock, and forest resources across different agro-ecological zones. Traditional farming systems maintain crop diversity, local varieties, and indigenous livestock resources, contributing to resilience against climate variability and production risks. However, increasing commercialization and specialization toward high-value commodities such as vegetables, dairy, and emerging crops may influence traditional agro-biodiversity patterns over time (NSB, 2025; MoAL, 2025).

Forest, agricultural, and rangeland ecosystems provide essential services that sustain rural livelihoods, including water regulation, soil conservation, carbon storage, fodder and fuel supply, and habitat support. These ecosystem services are particularly important in mountain environments where land degradation, erosion, landslides, and climate-related hazards directly affect agricultural productivity and household resilience (Wangchuk et al., 2021; CIFOR-ICRAF, 2019).

Biodiversity components such as pollinators and beneficial organisms also contribute to agricultural productivity, particularly in diversified horticultural systems. Maintaining habitat connectivity, agroforestry, and sustainable production practices can enhance both biodiversity conservation and ecosystem resilience (IPBES, 2019; Dainese et al., 2019).

Human–wildlife conflict remains a major challenge in eastern Bhutan, particularly in areas, where agricultural land borders forests and protected areas. Crop damage and livestock losses from wildlife species such as wild boar, deer, and bears reduce farm profitability and can discourage agricultural investment. Addressing HWC requires integrated landscape approaches combining community-based management, improved mitigation measures, and sustainable land-use planning (Sangay & Vernes, 2008; Wangchuk et al., 2023).

The FSIP baseline assessment provides an opportunity to establish evidence on agro-biodiversity, ecosystem service dependence, biodiversity-friendly production practices, and HWC impacts on rural livelihoods. These

findings will support interventions that promote sustainable food systems while maintaining biodiversity and ecosystem resilience.

3.6 Climate Change and Environment Risks

The Eastern Himalaya is one of the regions where the impacts of climate change are most evident and are expected to have significant consequences for mountain agriculture, food systems, and ecosystems. Bhutan has experienced rising temperatures, changing rainfall patterns, and more frequent climate-related hazards, increasing the vulnerability of agricultural production and rural livelihoods. This review draws primarily on analyses by the National Centre for Hydrology and Meteorology (NCHM), supported by climate projections and relevant literature.

3.6.1 Climate Trends, Variability and Projections

NCHM's climate assessment is based on long-term observations from 20 Class-A agrometeorological stations, including those within the six project Dzongkhags, complemented by climate projection models. The assessment provides evidence of historical climate trends, current variability, and projected future conditions.

3.6.2 Temperature Trend and Projections

Bhutan has experienced a sustained warming trend since the 1960s, with minimum temperatures increasing faster than maximum temperatures. Average temperatures have risen by approximately 1.5°C over the past five decades, broadly consistent with global warming trends. According to the **State of the Climate Report 2024**, 2024 was the warmest year on record, with a national average maximum temperature of 23.31°C and minimum temperature of 12.51°C (NCHM, 2025).

Across the project Dzongkhags, maximum temperatures exceeded 30°C during 2024, with Lhuentse and Pemagatshel experiencing prolonged periods of high temperatures. Climate projections under the SSP2-4.5 scenario indicate continued warming, with minimum temperatures expected to increase by about **1.5–2.0°C by the 2040s** and **2.5–3.0°C by the 2060s**. Warming is projected across all project areas, although southern Dzongkhags are expected to remain warmer than higher elevations.

Table 3.2: Annual extreme record of temperature (2025)

Dzongkhag	Maximum Temp °C	Minimum Temp °C	Station and Avg. Temp.
Sarpang, Bhur	40°C	8°C	Bhur, Country highest. Max: 25th May, 23 Sept, Min: 22nd Jan (189 days above 30°C) Avg. max: 29.49°C, Avg. min: 18.20°C
Lhuentse (Tangmachu)	37°C	4.5°C	Max: 21 Sept, Min: 15th Jan, (109 days above 30°C) Avg. max: 26.42°C, Avg. min: 15.23°C
Mongar	33°C	4°C	Max: 26 May, Min: 26 -28 Jan, (30 days above 30°C) Avg. max: 22.65°C, Avg. min: 13.74°C
Pemagatshel	36°C	3°C	Max: 22 Sept, Min:22 Jan – 4 Feb, (97 days above 30°C) Avg. max: 23.77°C, Avg. min: 13.54°C
Samdrup Jongkhar (Deothang)	35°C	8.5°C	Max: 23-24 Sept, Min: 7th Feb, (59 days above 30°C) Avg. max: 25.62°C, Avg. min: 17.99°C
Trashigang (Kanglung)	32°C	1.0°C	Max: 5th July, Min: 6th Feb, (17 days above 30°C) Avg. max: 23.11°C, Avg. min: 10.98°C
Trashiyangtse	32°C	- 1.5°C	Max: 21 March, Min: 18-19 December, 1-15 Jan, 11-12Feb Avg. max: 22.50°C, Avg. min: 10.16°C, (17 days above 30°C)
Haa	26°C	-0.9°C	Max: 27 Sept, Min:24 Dec (Lowest in the country, 131 days below 0).

(Source: NCHM State of Climate Report, 2025)

3.6.3 Rainfall Trend and Projections

Bhutan's rainfall remains highly seasonal, with about 72% occurring during the southwest monsoon (June–September). Rainfall distribution varies considerably because of topography and proximity to the Bay of Bengal. In 2024, national annual rainfall was broadly consistent with the long-term average, although substantial spatial variation was observed across the project area.

The project landscape exhibits strong climatic contrasts. Lhuentse and Mongar receive comparatively low annual rainfall, while the southern Dzongkhags of Pemagatshel and Samdrup Jongkhar receive substantially higher precipitation. Analysis of the BOKU-Met climate dataset similarly indicates annual rainfall ranging from approximately 670 mm in Mongar to 3,020 mm in Samdrup Jongkhar**,** highlighting markedly different climate-related risks across the landscape.

Climate projections suggest increasing precipitation in northern and central Bhutan, particularly during the summer monsoon, while eastern and south-eastern Dzongkhags, including Samdrup Jongkhar, Pemagatshel, Mongar, and Trashigang, are expected to remain relatively drier than other parts of the country.

The project area also exhibits substantial thermal variation, with mean annual temperatures ranging from approximately 9.5°C in Trashigang to 19.3°C in Mongar, reflecting its diverse topography and agroecological conditions.

Table 3.3: Seasonally accumulated and annual extreme records of rainfall (mm) (2024)

Dzongkhag	Acc. rainfall MAM	Acc. rainfall JJAS	Acc. rainfall ON	Total Annual Rainfall	No of days >1mm	24-hour rainfall (mm)	Rainfall date
Phuntsholing	857.6	4768.4	1082.4	6713.60	166	210.6	Country highest, 7th May
Lhuentse (Tangmachu)	175.8	269.6	58.4	513.20	84	27.6	Lowest, 21 March
Mongar	200.2	530.8	114.8	864	97	53.8	
Pemagatshel	390.6	1045.7	104.6	1560.30	97	194.4	
Samdrup Jongkhar (Deothang)	319.4	2060.6	274.7	2656.90	96	165	
Trashigang (Kanglung)	294.3	663.9	46.2	1018.80	97	64.6	
Trashiyangtse	328.4	641.9	93.4	1085.20	139	58	

(Source: NCHM State of Climate Report ,2025)

3.6.4 Climate-Related Hazards

Climate change is increasing the frequency and severity of environmental hazards affecting the project landscape. In the northern Dzongkhags, glacier retreat and shrinking snow cover threaten dry-season water availability and increase the risk of glacial lake outburst floods (GLOFs). At lower elevations, rising temperatures and changing rainfall patterns are contributing to shifts in the distribution of agricultural pests and diseases, increasing production risks.

Satellite-based land-use analysis (2010–2020) provides further evidence of climate change impacts. Snow and glacier cover declined by 59%**,** accompanied by expansion of alpine scrub and meadow vegetation, reflecting an upward shift of vegetation zones. These changes have important implications for downstream water resources, rangeland hydrology, and agricultural production within the project area.

3.6.5 Implications for Agriculture and Livelihoods

The observed and projected climate changes present significant challenges for agricultural production and rural livelihoods. Rising temperatures, increased heat stress, and changing rainfall patterns are reducing crop productivity, disrupting planting calendars, and increasing the occurrence of droughts, floods, and waterlogging. Warmer conditions are also expanding the range of agricultural pests, diseases, and invasive species, increasing production losses and management costs.

These interacting climate stresses threaten agricultural productivity, natural resources, and food security while reducing the resilience of farming households. Beyond primary production, climate change is expected to affect food processing, storage, transportation, and market systems, with implications for food availability, access, and nutrition. These trends highlight the importance of strengthening climate-resilient agricultural practices and adaptive management throughout the project landscape.

3.7 Gender Equality, Demography, and Social Inclusion

According to the National Statistics Bureau (NSB, 2022), approximately 61% of Bhutan's population resides in rural areas, where communities depend substantially on natural resources for food, medicine, and other basic needs. Agriculture remains a major source of rural livelihoods, engaging an estimated 42–44% of the labour force (FAO, 2025). Women constitute nearly half of Bhutan's population and play an important role in agriculture and rural household economies. However, gender disparities persist in employment and economic participation, with women accounting for approximately 46% of employment compared with 54% for men. Furthermore, women head approximately 33–35% of households, highlighting their significant role in household management and resource allocation (NSB, 2017b).

Gender roles in rural Bhutan are influenced by traditional social norms and gendered divisions of labour, with women often carrying a disproportionate share of unpaid domestic and care responsibilities alongside their agricultural activities. These constraints can limit women's access to productive resources, skills development, economic opportunities, leadership and decision-making. At the same time, women's substantial contribution to agriculture and household management presents an important opportunity to strengthen their agency and participation in rural development initiatives.

Social inclusion also remains relevant for **youth and persons with disabilities**. Youth participation in agriculture is constrained by increasing engagement in education and non-farm employment, while persons with disabilities may face barriers to skills development, access to productive resources, finance and employment. These structural and social constraints can limit their participation in agricultural value chains and livelihood opportunities.

The project should adopt an inclusive and gender-responsive approach that strengthens women's access to skills, productive resources, finance, markets and decision-making opportunities, while recognizing their unpaid care and labour burdens. Targeted opportunities should also be provided for youth and persons with disabilities**,** with sex-, age- and disability-disaggregated indicators used to monitor equitable participation and benefits.

3.8 Institutional Capacity and Governance

The performance of Bhutan's agri-food systems depends on strong institutions, effective governance, and coordinated service delivery. This section reviews evidence on extension services, farmer organizations, and local governance mechanisms.

3.8.1 Extension Systems

Agricultural extension has contributed to improved crop production, seed selection, environmental management, and farmer well-being but remains constrained by low farmer participation, limited market-oriented advisory services, and capacity gaps among extension personnel (Shangshon et al., 2023). Support for marketing, value chains, and price information remains weak, limiting the transition from subsistence to commercial agriculture, while larger farmers tend to benefit more than smallholders, raising equity concerns (Shangshon et al., 2023). Key capacity gaps include technical knowledge, extension methods, policy awareness, and situational analysis (Rigyal & Wongsamun, 2011). Strengthening demand-driven,

decentralized extension systems, competency-based training, digital tools, and targeted support for smallholders remains a priority (Shangshon et al., 2023; Rigyal & Wongsamun, 2011).

3.8.2 Farmer Group and Cooperatives

Farmer group and cooperatives demonstrate good production potential but are constrained by weak governance, leadership, market linkages, organizational capacity, and access to finance and technology, limiting their sustainability and competitiveness (Wangmo et al., 2021a; Wangmo et al., 2021b). In the dairy sector, cooperatives contribute to milk collection, processing, and income generation but face stagnant membership, limited diversification, financial pressures, and institutional weaknesses, with Dairy Farmers' Groups often outperforming cooperatives (Choden et al., 2022; Penjor & Gyeltshen, 2022). Leadership quality, market orientation, youth engagement, and member participation consistently influence organizational performance, while government dependency and weak incentives contribute to declining membership (Kuenga & Gurung, 2022; Dorji & Gurung, 2022a; Dorji & Gurung, 2022b). Strengthening governance, human capital, market access, value addition, financial services, and institutional self-reliance is therefore essential for building resilient and market-oriented farmer organizations (Wangmo et al., 2021a; Choden et al., 2022).

3.8.3 Local Governance Mechanisms

Effective coordination remains fundamental to agricultural development. Although recent policies promote multi-sectoral collaboration among government agencies, local governments, development partners, civil society, academia, the private sector, and farming communities (MoAL, 2023; MoAL, n.d.), implementation continues to be constrained by weak institutional coordination, unclear roles, limited stakeholder engagement, and insufficient ownership (Knowles, 2009). Similar challenges are evident at community level, where weak coordination between service providers, extension systems, and farmer organizations reduces participation and service effectiveness (Shangshon et al., 2023; Choden et al., 2022). Strengthening governance, institutional capacity, stakeholder partnerships, and demand-driven coordination mechanisms will be critical for improving service delivery, collective action, and sustainable agri-food system development (Sonam & Martwanna, 2012; Choden et al., 2022).



Pics 3: Bumdeling (Trashiyangtse)



Pics 4: Samdrupcholing vegetable market, Samdrup Jongkhar

4. Baseline Approach and Data Considerations

4.1 Alignment with Baseline Framework

The baseline survey follows the indicator framework presented in the Scope of Work, organized across 13 dimensions (Sections 6.1–6.13 of this report). Each dimension maps directly to one or more GEF Core Indicators and project outcome indicators. The mapping is summarized in **Table 4.1** below and the detailed indicator mapping is provided in the annexure (Annexure 5).

Table 4.1: High-level indicator mapping

Baseline Section (Findings)	GEF Core Indicator(s)	Project Outcome Indicator(s)
6.1 Demographics	CI 11	Beneficiary counting
6.2 Land tenure	CI 4.3, Gender	Output 2.1.1
6.3 SLM	CI 4.3	CI 11, Output 2.1.1
6.4 Rangeland	CI 3.1	CI 3.1
6.5 Production	CI 4.3, CI 6	Outcome 2.1
6.6 Biodiversity	CI 4.1	CI 4.1
6.7 Climate	CI 6	Outcome 2.1
6.8 Livelihoods	CI 11	Outcome 2.2
6.9 Food security	–	Outcome 2.1, 3.1
6.10 Gender	CI 11, GAP	Gender Action Plan
6.11 Institutions	CI 11	Outcome 1.1
6.12 Knowledge, Attitude and Practice	–	Output 3.2.1
6.13 Safeguards	ESMP/SEP	ESS compliance

4.2 Baseline Data Gaps

The baseline assessment relied on a combination of secondary and primary data sources to establish benchmark values for project indicators. A review of existing datasets was undertaken to assess data availability, quality, coverage, and suitability for project-level monitoring. While several national and sectoral databases provide useful information, significant gaps were identified in terms of data granularity, completeness, timeliness, and consistency. Consequently, primary data collection was required to establish project-specific baseline values, while available secondary data were used primarily for validation and triangulation purposes.

4.2.1 Secondary Data Availability

Prior to primary data collection, the baseline team reviewed a range of secondary sources, including:

- National Statistics Bureau (NSB) HH surveys;
- Ministry of Agriculture and Livestock (MoAL) annual reports;
- Renewable Natural Resources (RNR) statistics;
- Gewog-level agriculture extension records;
- Past project completion reports;
- GEF-8 project documents;
- Farm Registration System Records; and
- National Land Use and Landcover (LULC) datasets.

Although these sources provided useful contextual information, data availability and quality varied considerably across sectors and administrative levels. In particular, Dzongkhag- and Gewog-level data were often incomplete, inconsistent, outdated, or insufficiently disaggregated to meet the project's monitoring

requirements. Since the project indicators require baseline information at the intervention Gewog level, many existing datasets were not fully fit for purpose. Accordingly, secondary data were used where available to validate findings and triangulate information generated through primary surveys and stakeholder consultations.

The review identified several key data gaps and corresponding mitigation measures adopted during the baseline assessment (**Table 4.2**).

Table 4.2: Key data gaps identified

Data Gap	Implications for Baseline	Mitigation Approach
No recent (post-2020) soil health data at Gewog level	Limits independent verification of soil degradation and fertility status	HH reporting supplemented by field observations and stakeholder consultations
Incomplete livestock productivity records (milk yield, egg production) at HH level	No reliable benchmark available for productivity indicators	Dedicated livestock modules incorporated into HH surveys
Absence of historical rangeland condition data for Merak and Sakteng	Prevents assessment of long-term degradation trends	Baseline establishes a reference benchmark for future monitoring and evaluation
Outdated land use and land cover datasets	Reduces accuracy of area estimates for degradation and sustainable land management indicators	GIS analysis supplemented by field verification and GPS-based ground-truthing
Incomplete training records disaggregated by gender and disability	Limits verification of participation and inclusiveness indicators	HH recall data used, with limitations duly acknowledged
Limited systematic records on human-wildlife conflict incidents at Gewog level	Restricts objective assessment of conflict trends and impacts	HH responses triangulated through KIIs and local administrative records
Lack of disaggregated value chain and commodity marketing data for smallholders	No baseline available for several market and commercialization indicators	Commodity-specific survey modules used to establish baseline values

Assumptions applied in interpreting the baseline and the methodological limitations affecting comparability are consolidated in Section 5.7.



Pics 5: Narang, Mongar

5. Methodology

5.1 Survey Design

The baseline assessment employed a systems-based mixed-methods design combining quantitative and qualitative approaches to generate comprehensive baseline evidence across the project landscapes. The methodology was guided by the Project Unified Baseline Framework and aligned with Global Environment Facility (GEF) Core Indicator requirements (GEF, 2022).

Primary data were collected through structured HH survey, FGDs, KIIs, direct field observations, and GPS-enabled documentation, complemented by a review of relevant secondary data.

A stratified multi-stage random sampling design was applied for the HH survey to ensure representative coverage across Dzongkhags, Gewogs, production systems, and socio-economic conditions. The integration of household surveys with qualitative assessments and secondary information enabled triangulation of findings, improving the validity, reliability, and contextual interpretation of the baseline results (Creswell & Plano Clark, 2018).

5.2 Sampling Framework and Sampling Distribution

5.2.1 Sampling Framework and Household Selection Procedure

The survey covered farming and livestock-dependent HH across 23 Gewogs in six project Dzongkhags. The sampling framework was designed to ensure representative coverage across diverse agro-ecological zones, livelihood systems, and socio-economic conditions within the project area.

A multi-stage stratified random sampling approach was applied, where Dzongkhags and Gewogs formed the primary sampling units, Chiwogs the secondary units, and villages as the enumeration areas (**Table 5.1**). Following the selection of Chiwogs and villages, the 2024 National Statistics Bureau (NSB) sampling frame was used to randomly select Enumeration Areas (EAs), and sample sizes for each Chiwog were allocated proportionately to the household population.

HH listing was then conducted within each selected EA in collaboration with local leaders, Gewog officials, and extension staff to establish an accurate and sampling frame. Based on the predetermined sample allocation for each Gewog and Chiwog, households were selected using systematic circular random sampling, ensuring representative coverage of different farming and socio-economic groups within the selected villages while minimizing coverage error.

Where a selected household was unavailable because of absence or refusal, up to three revisit attempts were made before replacement. If revisits were not feasible because of difficult terrain, adverse weather, or continued unavailability, the immediate adjacent household on the listing was selected following the same sampling protocol. In total, 10 households (2.4%) were replaced, resulting in a 97.6% successful response rate, indicating that non-response bias is unlikely to have materially affected the findings.

5.2.2 Stratification Rationale

Stratification was employed to enhance representativeness and statistical efficiency across the geographically and socio-economically diverse project landscape characterized by variation in farming systems, livestock management practices, market access, and topography.

By ensuring adequate representation across Dzongkhags, Gewogs, Chiwogs, and villages, the approach reduced sampling variance and improved estimation precision compared to simple random sampling (Cochran, 1977). It also enabled robust disaggregated analysis across administrative and geographic units, providing a robust basis for project monitoring, evaluation and the targeting of interventions.

5.2.3 Sample Size Determination

The sample size was computed using Cochran's (1977) finite population correction formula at a **95% confidence level and 5% margin of error**, based on a total population of 10,334 HH. The formula was considered appropriate given the relatively finite project population size of 10,334 HH across the 23 target Gewogs.

The sample size was calculated using the following formula:

$$n = \frac{N\ x\ Z^2\ x\ p(1-p)}{e^2\ (N-1) + Z^2\ x\ p(1-p)}$$

where: n = required sample size,
N = total number of HH (10,334),
Z = Z-value corresponding to the desired confidence level (95% = 1.96);
p = estimated population proportion (assumed at 0.5 to maximise sample size);
e = margin of error (5%=0.05).

Substituting the values into the formula:

$$n = \frac{10334\ x\ (1.96)^2\ x\ 0.5(1-0.5)}{(0.05)^2\ (10334-1) + (1.96)^2\ x\ 0.5(1-0.5)}$$

$$n = \frac{9926.6}{26.7929} \approx 371$$

A 11% allowance for non-response was added, resulting in a final sample size of approximately 412 HHs. This adjustment is consistent with standard survey practice to account for field-level non-response and incomplete interviews (**Table 5.1**).

$$N_{final} = 371 \times 1.11 \approx 412$$

The sample size for each Gewog was determined using proportional allocation based on the total number of HH within each Gewog using the following formula:

$$n_h = \frac{N_h}{N} \times N_{final}$$

Where:
n_h = sample size for a specific Gewog
N_h = total HH in the Gewog
N = total HH in the project area
Nfinal = total survey sample size

For example, the sample size for Drepong Gewog was calculated as follows:

$$n_h = \frac{252}{10334} \times 412 \approx 10$$

The final HH sample distribution is presented in **Table 5.1**.

Table 5.1: Sampling framework for HH survey

Gewog	Total HHs	Sample Size	Total Chiwogs	Sampling Chiwog	Chiwog HHs	Sample per Chiwog	Enumeration Area
Tsaenkhar	497	21	5	Go-Nyid_Wambur	107	7	Chhimgong, Sokarom & Yangloong
				Domkhar_Umling	96	5	Domkhar, Umling & Dongling
				Autsho_Chharbi	152	9	Lawsa, Tarka Shing, Tongphugang & Shermachhu
Minjey	254	11	5	Chusa_Legshogang	38	2	Legpachhu
				Minjey_Wangzhing	122	5	Neyka, Tongling & Wangzhing
				Boo-Dur_Kupi-Nyalsa	61	4	Boo-dur & Jakang
Drepoong	252	10	5	Boompazor_Drepoong	63	4	Drepoong & Boompazor
				Bainangri_Nyamla	39	2	Nyamla
				Zunglen	66	4	Zunglen & Sib
Silambi	335	13	5	Daag	25	1	Daag
				Pang_Nagor	157	9	Nagor, Pang Gyerteng, Kangkangma & Nagor Goenpa
				Kadag_Silambi	63	3	Baribang & Silambi
Jurmed	304	13	5	Bilam_Dangkila	95	5	Maphel & Korkhang
				Kognala_Ya-Ragla	42	2	Kognala
				Moodoongkhar_Tselam	71	3	Karmaling & Tsela
				Moogtangkhar_Tsangkhazor	64	3	Moogtangkhar & Tsangkhazor
Narang	225	9	5	Thrinangphu	50	2	Thrinangphu
				Gomchhu	32	2	Gomchhu
				Na-Rang_Pangthang	39	2	Chhema
				Dongshoom_Pangkhang	51	3	Pangkhang & Raynangkhar
Dechheling	630	25	6	Doongchhilo_Kholomri	70	4	Doongchhilo & Kholomri
				Doongphu_Shingchongri	106	6	Shingchongri
				Dechhenling_Goenpawoong	190	11	Bata, Dechhenling, Martshala & Goenpawoong
				Goishing_Ridzommo	59	4	Ridzommo & Goishing
Nanong	524	21	5	Nanong	192	10	Nanong, Pangthang, Zhingri & Kuloong
				Raling	38	2	Denphu
				Tokarey	48	3	Bargoenpa & Tokarey
				Terphu_Woongchhiloo	109	6	Gayri, Maenjoong & Woongchhillo
Zobel	385	15	5	Zobel	50	3	Zobel
				Ngangmalang_Zorjoog	157	6	Zorjoog, Ridurba & Ngangmalang
				Raysinang	43	2	Raysinang
				Maan_Tshelinggor	89	4	Tshelinggor & Pangthang
Langchenphu	284	11	5	Jampani	24	2	Jampani
				Langchenphu	89	5	Langchenphu Maed & Langchenphu Toed
				Jangsa	59	4	Namchagzor & Jangsagom
Gomdar	611	24	5	Brumi Chidungkhar	165	7	Barzor, Fremi, Broomi
				Denchhi	164	6	Denchhi
				Khoyar Pangthang Palrung	62	2	Bargoenpa
				Gomdar Richhanglu	181	7	Richhanglu, Gomdar, Sawang & Amshing
				Narphung	39	2	Narphoong
Martsalla	621	24	6	Sarjoong	100	5	Sarjoong
				Kaeptang_Tsholingkhar	152	7	Pelrithang, Tsholingkhar, Richhanglu & Dingshingzor
				Tshotsalo	66	3	Raushing & Tshautshalo
				Martshala	173	9	Martshala, Kakpadoong, Gorthongma & Doongmanma

Gewog	Total HHs	Sample Size	Total Chiwogs	Sampling Chiwog	Chiwog HHs	Sample per Chiwog	Enumeration Area
Lauri	545	21	5	Momring_Rolnang	96	5	Phajo Gonpa, Momring & Rolnang
				Gonong_Zangthig	79	4	Gonong & Serzhong,
				Betseling_Doongmanma	85	4	Betseling & Doongmanma
				Lauri	160	8	Patpanadang, Lauri, Woongthig & Woong
Serthi	373	15	5	Khandophu_Minjiwoong	176	8	Minjiwoong, Phakchhu, Tang Phrang & Woong
				Dangtsho_Serthig	56	3	Lamkhabji & Pangthang
				Monmola_Tashithang Gyed	94	4	Barkalangnang & Gonpa
Lumang	750	29	6	Kharphu_Kurchhilo	168	8	Deno Kharphugoenpa, Kharphu & Darna
				Riserbu_Tsangpo	239	9	Kheri, Sethang, Tokaphu & Tsangpo
				Moochhu_Wakhar	167	9	Moochhu, Phoogaye & Baynangwoong
				Tshogoenpa	83	3	Wamrong & Gangtong
Kangpar	497	20	5	Bedengphu_Merdag	74	4	Bedengphu & Dangsa
				Thelphu	28	2	Threlphu/Buchhila
				Zordung	93	5	Betsa, Zordoong & Shingshoogpa
				Kangpar_Lamyong	173	9	Kangpar, Neyling, Kheshing & Lamyong
Khaling	603	24	6	Jiri_Lemi	89	5	Jiri, Liza & Lemi Chhamzor
				Barshong	95	6	Barshong, Monganthoong & Woongnangphu
				Gomchhu_Kholdoong	77	5	Dreywoong, Khochiphai & Tsangpo
				Khaling	137	8	Daksa, Thripang Goenpa, Rashu-woong & Jirichhu
Yangnyer	557	23	5	Daliphang_Ragshigo	114	4	Daliphangma & Korkhang
				Duroong_Ngambinang	33	1	Duroong
				Dargyeling_Kharthoong	190	8	Chhangzoe & Dargyeling
				Shokang_Tegtegpa	95	4	Shokang & Gongzor
				Kharza_Leyphu	125	6	Kharza, Riserbu & Gyenthoong
Merak	345	14	5	Merag Toed	95	3	Pangpa & Merag Toed
				Gyen-go	72	6	Gyen-go, Geyen-go Lamtag & Gyen-go Phiriteng
				Merag Maed	145	5	Merag Maed, Joogpa
Sakteng	330	13	5	Borangmang_Borangtse	50	4	Borangmang
				Sagteng	140	5	Sagteng
				Pusa_Tenmang	110	4	Tenmang
Khamdang	680	27	5	Serpang_Shalli	173	10	Serpang, Drenglum & Pam
				Nombaring_Shazam	165	9	Dholepchen & Shazam
				Khamdang_Manla	155	8	Khamdang
Bumdeling	408	16	5	Pangkhar_Taphel	136	6	Chheng & Tarphel
				Ngalimang_Phanteng	67	3	Ngalimang & Phanteng
				Betsamang	70	2	Betsamang
				Bomdhir_Wogmanang	67	2	Bomdhir
				Gangkhardoong_Tshaleng	68	3	Gangkhardoong & Tshaleng
Ramjar	324	13	5	Dhomtshang_Doongmaen	61	4	Dhomtshang & Kakani
				Lengbartang_Woongkhar	48	3	Gongshing & Zorthoong
				Bainang-Reb_Romang	71	5	Lemnang, Sarjab & Boenkangzor
				Khalapangthang_Tsang-Rong	24	1	Goenpa
TOTAL	**10,334**	**412**			**8301**	**412**	

5.3 Data Collection Methods

Primary data were collected using a structured HH survey, KIIs, FGDs, direct field observations, GPS-enabled documentation, complemented by a review of relevant secondary literature and project documents. Combining multiple data sources strengthened triangulation and provided both quantitative evidence and qualitative insights into the project's environmental, social, institutional, and livelihood context.

Household survey data were collected using the KoboCollect digital platform, which improved data quality through built-in validation rules, skip logic, standardized data entry, and real-time field monitoring, thereby reducing transcription errors and strengthening field supervision (FAO, 2017; Kobo Toolbox, 2024).

5.4 Survey Instruments and Modules

The structured household questionnaire comprised modules on household demographics, land use, crop and livestock production, agricultural inputs, extension services, climate-smart agriculture practices, market access, post-harvest management, and exposure to production shocks, including climate variability, pests, diseases, and human-wildlife conflict.

FGDs with farmers and community groups explored production constraints, livelihood strategies, gender and social inclusion, institutional arrangements, market linkages, climate risks, and natural resource management. KIIs with extension personnel, local leaders, and sector officials provided expert perspectives and validated survey findings. Together, these instruments enabled systematic triangulation and strengthened the evidence base for the baseline assessment.

5.5 Data Analysis and Indicator Development

5.5.1 Descriptive and Comparative Analysis

Household (HH) survey data were primarily analysed using Microsoft Excel, which was sufficient for the level of analysis required for this baseline assessment. Given the descriptive and indicator-based nature of the study, advanced statistical modelling was not necessary. Excel provided an efficient platform for data cleaning, aggregation, computation of indices, and generation of summary statistics in a transparent and reproducible manner.

The analysis focused mainly on descriptive statistical methods, which are standard in most HH survey-based agricultural and socio-economic assessments. These included:

- Frequencies and percentages to summarize categorical variables such as adoption of practices, livestock ownership, and land use patterns;
- Means, medians, and ranges to describe continuous variables such as landholding size, crop area, and input use;
- Cross-tabulations to compare key indicators across Dzongkhags, Gewogs, or farming systems; and
- Index construction and aggregation, including computation of composite indicators such as the Land Degradation Index and other derived indices used in the baseline assessment.

Where relevant, simple consistency and validation checks were also applied to ensure logical coherence between related variables (e.g., land area versus cropped area, livestock numbers versus manure availability).

These analytical approaches are consistent with standard practices in HH survey analysis, particularly for baseline studies and monitoring frameworks, where the objective is to generate reliable descriptive evidence rather than inferential or causal modelling. This approach aligns with established survey methodologies commonly used by FAO and the World Bank in agricultural and rural development assessments (FAO, 2020; World Bank, 2021).

5.5.2 Index Construction

In addition to the indicators included in the Project Results Framework, the baseline assessment developed a set of complementary composite indices derived from the HH survey. These indices provide additional evidence for assessing agricultural sustainability, land health, agrobiodiversity, climate resilience, and

rangeland condition across the project landscape. While these indices are not included in the project's formal Results Framework, they provide complementary evidence for interpreting baseline conditions and monitoring changes in agro-ecosystem performance over time. The indices are adapted from internationally recognised scientific frameworks and tailored to Bhutan's mountain farming systems and the data collected through the baseline survey.

Land Degradation Index (LDI)

The Land Degradation Index (LDI) measures the extent and severity of land degradation as perceived by farming households. The index is adapted from the Land Degradation Neutrality (LDN) framework of the United Nations Convention to Combat Desertification (UNCCD, 2017) and the Land Degradation Assessment in Drylands (LADA) methodology (FAO, 2011). It incorporates household-level information on soil erosion, declining land productivity, vegetation loss, landslides, and land abandonment, thereby complementing the project's Sustainable Land Management (SLM) indicators by assessing land condition rather than the area under improved management.

Each degradation indicator was scored as 0 = no degradation, 1 = moderate degradation, and 2 = severe degradation. The index was calculated as:

$$LDI = \frac{\sum D_i}{N}$$

Where:

D_i = degradation score for household i
N = total number of households surveyed

Higher LDI values indicate greater perceived land degradation.

HH Crop Richness Index (HCRI)

The Household Crop Richness Index (HCRI) was used as a proxy measure of on-farm agrobiodiversity. Crop diversity contributes to food security, ecosystem functioning, climate resilience, and the conservation of plant genetic resources (FAO, 2019). Households cultivating a wider range of crop species and varieties are generally more resilient to climatic variability, pests, diseases, and market fluctuations.

Crop richness, the total number of crop species or varieties cultivated, is one of the simplest and most widely used measures of biodiversity (Magurran, 2004). Because the household survey collected only the number of crop varieties cultivated by each household, a normalized crop richness index was calculated as:

$$HCRI_i = \frac{S_i}{S_{max}}$$

Where:

$HCRI_i$ = Household Crop Richness Index for household i
S_i = number of crop varieties cultivated by household i
S_{max} = maximum number of crop varieties recorded among all surveyed households

The index ranges from 0 to 1, where higher values indicate greater crop richness relative to other surveyed households.

For interpretation:

- < 0.30 = Low crop richness,
- 0.30–0.60 = Moderate crop richness,
- 0.60 = High crop richness.

The HCRI measures crop richness only and does not account for crop abundance, cultivated area, or species evenness (Magurran, 2004). Nevertheless, it provides a practical indicator of household-level agrobiodiversity where more detailed biodiversity information is unavailable (Jarvis et al., 2008; FAO, 2019).

Rangeland Condition Index (RCI)

The Rangeland Condition Index (RCI) assesses the condition of grazing resources based on household perceptions of pasture quality, forage availability, seasonal feed shortages, grazing distance, and dependence on supplementary feeding. The indicator is informed by established rangeland assessment methodologies and pastoral monitoring approaches (Holechek et al., 2011; Reid et al., 2008; FAO, 2021).

Households rated overall rangeland condition as: Good = 1.0, Moderate = 0.5, and Poor = 0.0.

The index was calculated as:

$$RCI = \frac{\sum R_i}{N}$$

Where:

R_i = rangeland condition score for household i
N = total number of households surveyed

Higher RCI values indicate better rangeland condition and forage availability.

Climate-Smart Agriculture Adoption Index (CSAI)

The Climate-Smart Agriculture Adoption Index (CSAI) measures the extent to which households have adopted climate-smart agricultural practices. The index is based on the FAO Climate-Smart Agriculture framework and reflects adoption of practices that improve productivity, strengthen resilience to climate change, and contribute to mitigation objectives (FAO, 2013; FAO, 2017; Lipper et al., 2014).

The index incorporates adoption of seven climate-smart agricultural practices at the household level: soil and water conservation measures, climate-resilient crop varieties, integrated pest management, organic nutrient management, improved fodder production, agroforestry, and water-efficient irrigation.

Each practice was assigned a binary score (1 = adopted; 0 = not adopted). The CSAI was calculated as:

$$CSAI = \frac{\sum A_i}{K}$$

Where:

A_i = adoption score for practice i
K = total number of climate-smart practices assessed

The index ranges from 0 to 1, with higher values indicating greater adoption of climate-smart agricultural practices.

5.5.3 Gender-Disaggregated Analysis

Gender-and socially disaggregated analysis was undertaken across relevant household, livelihood, resource-access, participation, training and decision-making indicators. Findings were disaggregated by sex, age group, household-headship status and vulnerability characteristics, where sample sizes permitted meaningful interpretation. Particular attention was given to women's and youth participation, access to productive resources and services, labour contributions, and decision-making roles.

5.6 Data Quality Assurance

5.6.1 Data Quality Management

Data quality assurance for the HH survey was ensured through a structured set of procedures aligned with internationally accepted standards for agricultural and socio-economic surveys, including FAO guidelines and the World Bank's Living Standards Measurement Study (LSMS) framework (FAO, 2018; FAO, 2020; World Bank, 2021). These procedures were applied across all stages of the survey, from questionnaire design to data validation, to ensure accuracy, consistency, and reliability of the dataset.

At the design stage, the HH survey, FGD, and KII questionnaires were rigorously reviewed by the Core Technical Team. All comments and feedback were systematically addressed and incorporated into the final instruments. To further strengthen their clarity, relevance, and field applicability, the tools were pre-tested during enumerator training. This exercise allowed for refinement of question wording, sequencing, translation, and overall flow prior to full-scale field deployment.

During data collection, enumerators were provided with standardized training covering survey objectives, interview techniques, ethical considerations, and uniform interpretation of indicators to minimize interviewer bias. Field supervisors conducted continuous monitoring and spot-checks to ensure adherence to sampling protocols and correct administration of questionnaires. In addition, daily field-level reviews were undertaken to identify missing responses, inconsistencies, and outliers, enabling immediate clarification or correction through respondent revisits where necessary.

In the post-collection phase, data were subjected to systematic validation procedures, including range checks, skip-pattern verification, and logical consistency tests. These checks helped identify and correct anomalies such as implausible livestock numbers, crop areas, or input usage. Where appropriate, data were further triangulated with secondary sources and internal consistency relationships (e.g., land size versus cropping intensity, and livestock holdings versus manure production potential).

Overall, these multi-stage quality assurance measures ensured that the dataset is robust, internally consistent, and suitable for reliable statistical and analytical use, in line with established international best practices for HH survey data management.

5.6.2 Handling of Missing Values and Outliers

Real-time checking during data collection - Data quality was managed continuously throughout fieldwork rather than only at the analysis stage. Because the survey was administered on a digital data-collection platform, submitted questionnaires were reviewed as they were received from enumerators. Daily field-level checks screened each submission for missing responses, skipped items, internal inconsistencies and implausible values, so that issues could be flagged and resolved while the enumerators were still in the field.

Missing values - Where required responses were found to be missing or blank, the affected records were referred back to the enumerator concerned for follow-up, and the values were retrieved through respondent re-contact or revisit wherever feasible. Responses that remained genuinely unavailable were retained as missing rather than imputed; each indicator is therefore reported against its valid-response base (n), with percentages calculated on the number of households that actually answered the relevant question. A small number of systematic gaps traced to form-logic or skip-pattern issues in specific modules were documented and excluded from the corresponding indicator so as not to distort the results.

Outliers - Implausible or extreme values, for example, unusually large livestock holdings, land areas or input quantities, were flagged through range checks and internal-consistency tests (such as landholding versus cropping intensity, and herd size versus manure-production potential). Every flagged value was then verified through follow-up with the enumerator or respondent: confirmed data-entry or unit errors were corrected under a documented set of correction rules, while values verified as genuine were retained unchanged.

Non-destructive cleaning - All cleaning was applied non-destructively — the raw survey values were never overwritten. Follow-up updates and corrections were held as a separate, auditable layer over the original data, so that every figure reported in this baseline can be traced back to what was collected in the field. This keeps the analysed dataset internally consistent and free of obvious entry errors while remaining faithful to the raw data, and makes the treatment of every missing or corrected value transparent and reproducible.

5.7 Assumptions for Baseline Interpretation

The section consolidates the assumptions applied in interpreting the baseline and the methodological limitations affecting comparability with future assessments, drawing together points relevant across the survey, sampling and analysis.

The baseline assessment establishes the pre-intervention status of key project indicators and provides reference point against which future progress, outcomes, and impacts will be measured during the Mid-Term Review

(MTR) and Terminal Evaluation (TE). Given data limitations, reliance on HH recall, and the absence of historical records for certain indicators, a number of assumptions were applied during the baseline assessment. These assumptions should be considered when interpreting baseline values and assessing project-induced changes over time (**Table 5.2**).

Table 5.2: Assumptions for baseline assessment

Assumption	Justification	Risk if Invalid
A1: Land area reporting – One acre is equivalent to 3 Langdo or 100 decimals, as specified in the survey instrument.	Standard land area conversion commonly used by MoAL and national statistical systems.	Inconsistent reporting across locations may affect area estimates. Mitigation: cross-check reported areas with extension records and field observations where possible.
A2: Self-reported crop yields – HH recall of crop production and cultivated area provides a reasonable estimate for baseline benchmarking.	Physical measurement of production was beyond the scope and resources of the baseline assessment.	Potential over- or under-reporting of yields. Mitigation: triangulate HH responses with FGD and local agricultural statistics.
A3: Three-year recall for trends – HH can reliably report trends in production, income, and grazing resources over the previous three years.	A three-year recall period is commonly used in agricultural and livelihood assessments to capture recent trends.	Recall bias may affect accuracy. Mitigation: trend questions focus on direction of change (increase, decrease, no change) rather than precise quantitative estimates.
A4: Rangeland section applicability – Rangeland management questions are relevant only to Merak and Sakteng Gewogs.	Project interventions related to rangeland management are confined to these areas.	Findings are not representative of other project locations; this should be recognized as a scope limitation rather than a data deficiency.
A5: Human-wildlife conflict perception – HH-reported incidents reflect local experience and perceptions of HWC**.**	No comprehensive and verified Gewog-level database on HWC incidents is available.	Perceptions may differ from officially recorded cases. Mitigation: triangulate findings through KIIs and available administrative records.
A6: GHG proxies as stand-ins for direct measurement – information on fuel use, fertilizer application, and manure management can serve as proxies for estimating greenhouse gas emissions.	Direct measurement of greenhouse gas emissions is beyond the scope of the baseline study and would require extensive, site-specific monitoring infrastructure.	Estimated values may not fully reflect actual emissions; however, proxy-based approaches are consistent with accepted GEF reporting methodologies.
A7: Food security as self-reported sufficiency – Months of HH food sufficiency from own production provide a reasonable measure of food security status.	This indicator is widely used in Bhutan's agricultural and rural livelihood surveys.	The indicator does not capture dietary quality or nutrition outcomes. Mitigation: complementary dietary diversity indicators are included in the HH survey.
A8: Current land degradation status serves as baseline–Existing land degradation conditions represent the starting point for future project monitoring.	Historical, high-resolution geospatial data for the target areas are limited or unavailable.	Long-term degradation trends cannot be quantified. Future assessments will measure changes relative to the 2026 baseline established under this study.

These assumptions do not invalidate the baseline findings; rather, they define the methodological boundaries within which the results should be interpreted and compared during subsequent project evaluations.

5.8 Limitations Affecting Baseline Comparability

The baseline findings should be interpreted in light of several methodological and contextual limitations that may affect comparability with future assessments as given below:

- Seasonal variation is a key consideration, as HH surveys were conducted in April. Conditions related to food security, income, livestock production, and grazing availability may differ across seasons. To enhance comparability, it is recommended that both the MTR and TE be conducted during the same seasonal period.
- Recall bias may have affected responses on changes in crop yields, HH income, and grazing resource over the previous three years. To reduce this limitation, the analysis focuses on broad trends (e.g., increasing, decreasing, or unchanged) and triangulates findings with FGD and KII data.
- Social desirability bias may have led some respondents to overreport the adoption of sustainable land management (SLM) and other environmentally sustainable practices. The risk was mitigated through assurances of respondent anonymity and field verification of selected practices.
- The limited sample size for rangeland HH, particularly in Merak and Sakteng, limits statistical disaggregation by gender, age, or other socio-economic characteristics. Consequently, rangeland-related findings are presented as descriptive statistics.
- Land area data were self-reported and not independently verified through field measurement, which may introduce some errors in estimates of cultivated land, pasture area, or land under sustainable management. While this approach is acceptable for baseline purposes, future assessments should consider GPS-based measurements for a validation subsample to improve accuracy and comparability.
- Language and literacy considerations may also have influenced responses to knowledge, attitude, and practice (KAP) and perception-based questions. This risk was minimized through translation into local languages, back-translation procedures and the use of trained local enumerators.
- In addition, the sampling frame, based on Gewog administrative records, may not fully reflect recent demographic changes such as HH formation, migration or temporary absence. Field work was also occasionally affected by difficult terrain, dispersed settlements, adverse weather and respondent unavailability, requiring revisits or substitution within the approved e sampling protocol. These are common in large-scale rural surveys and, mitigated through triangulation and standardized procedures, are unlikely to materially affect analytical validity.

While these limitations do not undermine the overall validity of the baseline findings, they should be considered when interpreting results and comparing changes observed during the MTR and TE.



Pics 6: Sheteymi, Merak, Trashigang

6. Baseline Findings and Discussions

6.1 Household Demographics and Social Profile

Every HH indicator in this section is examined through a gender lens, drawing on the gender of the respondent and HH head, the gender composition of HH members, and the survey's gender-disaggregated questions on land ownership, decision-making, labour time, training and access to resources. Where relevant, female-headed and male-headed HHs are compared, and youth and persons with disability are reported as distinct social-inclusion groups.

6.1.1 Household Demographics and Social Profile

The 412 surveyed HH comprise 1,380 enumerated members, of whom 48% are male and 52% female. **(Table 6.1**). Average HH size is modest at 3.6 (~4) members. The age–gender structure (**Table 6.1**, **Figure 6.1**) shows a youthful but constrained base: about 21% of members are children aged 1–14 and 14% are aged 65 and over, giving a dependency ratio of roughly 53 dependents per 100 working-age adults. The 15–24 youth group is comparatively low (13% of members), consistent with rural youth out-migration, a pattern that recurs in the labour and participation data below. The relatively low proportion of youth points to the importance of targeted strategies to enhance youth engagement in sustainable and commercially oriented agriculture.

Table 6.1: Age-gender structure of surveyed HH

Age group	Male (n)	Female (n)	Other (n)	Total (n)
1–14	150	134	2	286
15–24	84	92	0	176
25–65	339	383	4	726
65+	90	102	0	192
Total	**663**	**711**	**6**	**1,380**

(Source: Household Survey, 2026)

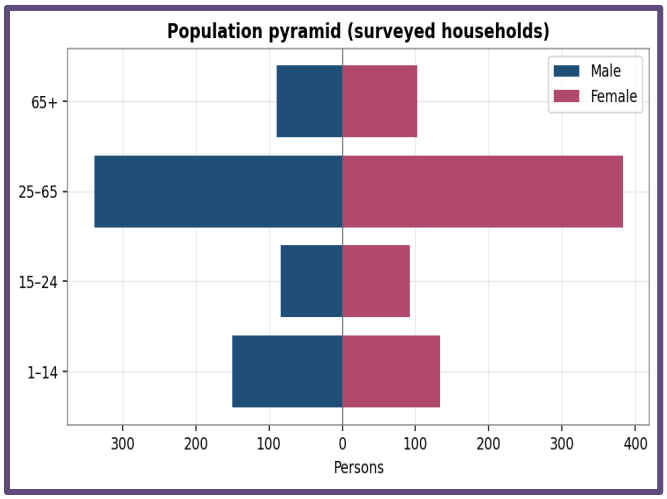


Figure 6.1: Age-gender structure of surveyed HH
(Source: Baseline HH Survey, 2026)

A defining feature of the project area is the prominence of women in HH leadership: 44% of HH are female-headed and women make up 52% of respondents (**Table 6.2**). This high share of women-led HH, well above the national average 35% (NSB, 2022) the project area's matrilinear inheritance traditions and male out-migration, and means that gender is not a peripheral cross-cutting theme but central to how the project area's farms are managed. The high proportion of female-headed households (44%) underscores the need for gender-responsive interventions that strengthen women's access to training, productive resources, and decision-

making opportunities. Disability is reported in 12% of HH **(Table 6.2),** which calls for inclusive approaches that ensure equitable access to project services and benefits.

Table 6.2: Demographic profile

Indicator	Baseline Values
Mean household size	4
Female-headed households (%)	44
Households with a member with disability (%)	12
Mean respondent age (years)	50
Female respondents (%)	52
Landless (%)	3
Elderly-headed (%)	17

(Source: Baseline HH Survey, 2026)

The data also reveal a clear gender gap in educational attainment (**Table 6.3**). Women are more likely to be illiterate than men (29% vs. 23%) and are twice as likely to have received non-formal education (16% vs. 8%), whereas men are more likely to have attained primary education (7% vs. 2%) or monastic education (6% vs. 0%). These findings suggest that women generally have lower levels of formal education, which has important implications for the design and delivery of training, extension, and behaviour change interventions to ensure they are accessible and inclusive and conduct training using practical, visual, and participatory learning methods.

Table 6.3: Education profile by gender

Gender	Illiterate (%)	NFE (%)	Primary (%)	Secondary (%)	Higher (%)	Monastic (%)	Total (%)
Female	29	16	2	2	2	0	52
Male	23	8	7	2	2	6	48
Total							**100**

(Source: Baseline HH Survey, 2026)

6.2 Land, Tenure and Resource Access/Use

HH cultivate on average 1.2 ha and hold 1.7 ha including fallow land (**Table 6.4**), distributed across wetland (chuzhing), dryland (kamzhing), khimsa, orchard and in the pastoral Gewogs' rangeland (Table 22.1). Land ownership is comparatively equitable by regional standards (**Figure 6.2**): men own land in 51% of HH, women in 37%, and a further 12% hold land jointly, so women own or co-own land in nearly half (49%) of HH. The relatively high level of female land ownership (49%) provides a strong foundation for actively engaging women in sustainable land management (SLM) and other natural resource management interventions.

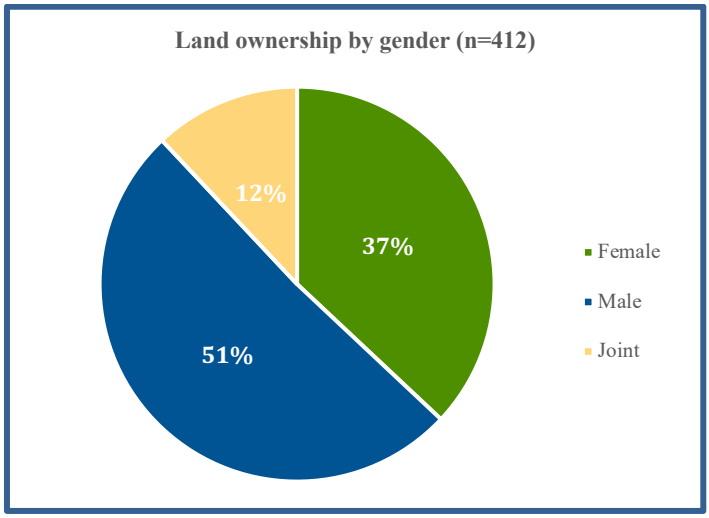


Figure 6.2: Land ownership by gender
(Source: Baseline HH Survey, 2026)

Table 6.4: Landholding by land type

Land type	HHs with land	Own cultivated (ha)	Leased (ha)	Fallow (ha)
Wetland (Chuzhing)	148	65.6	8.3	15.3
Dryland (Kamzhing)	378	261.6	27	163.3
Khimsa	288	41.8	4.5	3.0
Orchard	147	178.7	7	14.9
Rangeland/Pasture	58	64.2	2.8	8.6

(Source: Baseline HH Survey, 2026)

6.3 Land Degradation and Sustainable Land Management (CI 4.3)

6.3.1 Land Degradation Status

Land degradation assessment was conducted through direct HH enumeration, with respondents identifying, quantifying, and describing the degradation processes affecting their agricultural land (**Table 6.5)**. Of the 412 HH surveyed, 16% (67 HH) reported at least one form of active agricultural land degradation affecting their holdings. This proportion is consistent with the spatial degradation patterns identified through GIS analysis of the ICIMOD 2020 land degradation layer, which maps a total degrading area of 518 km² (51,792 ha) across the six Dzongkhags, confirming that HH perceptions represent a meaningful partial signal of the broader spatial degradation pattern. This highlights the need to prioritize degraded areas for restoration.

Four distinct degradation types were enumerated and quantified. Surface erosion was the most frequently reported process, affecting 33 HH with a mean degraded area of 0.28 ha per HH and a total survey-reported degraded area of 9.3 ha. Landslide damage affected 26 HH and represented the largest mean degraded area per HH at 0.41 ha, with a total of 10.7 ha. Gully erosion, while affecting the smallest number of HH (14), was associated with the largest mean area per HH at 1.3 ha, yielding a total of 18.1 ha, the single largest degradation type by aggregate area. This pattern is consistent with literature on gully dynamics in mountain contexts, where once initiated, gully systems expand rapidly and generate disproportionately large area losses (UNCCD, 2016; Cowie et al., 2018). Ravine formation, which is the most severe and least reversible degradation category, was reported by three HH with an aggregate total of 2.4 ha, indicating advanced-stage degradation where complete topsoil loss and subsoil incision have occurred. In aggregate, the survey identified a total of 40.5 ha of degraded agricultural land across 67 reporting HH.

Table 6.5: Survey-reported agricultural land degradation by type (n=412 HHs)

Degradation Type	No. HHs reporting	% of Total HHs	Mean Area (ha/HH)	Total Area (ha)
Surface erosion	33	8	0.28	9.3
Landslides	26	6	0.41	10.7
Gully erosion	14	3	1.3	18.1
Ravine / rill formation	3	1	0.81	2.4
TOTAL affected HH	**67**[1]	**16**	**—**	**40.5**

(Source: Baseline HH Survey, 2026)

The Land Degradation Index (LDI) is derived using the formula LDI = (sum of degradation scores across all HH) / n, where scores are 0 (none), 1 (moderate), or 2 (severe) per degradation type. Applying the HH-level degradation prevalence data, the project area LDI baseline is estimated at 0.163 on a normalized 0–1 scale, indicating that approximately 16% of the surveyed HH is experiencing measurable land degradation giving a baseline reference for tracking LDN-related progress at program evaluation.

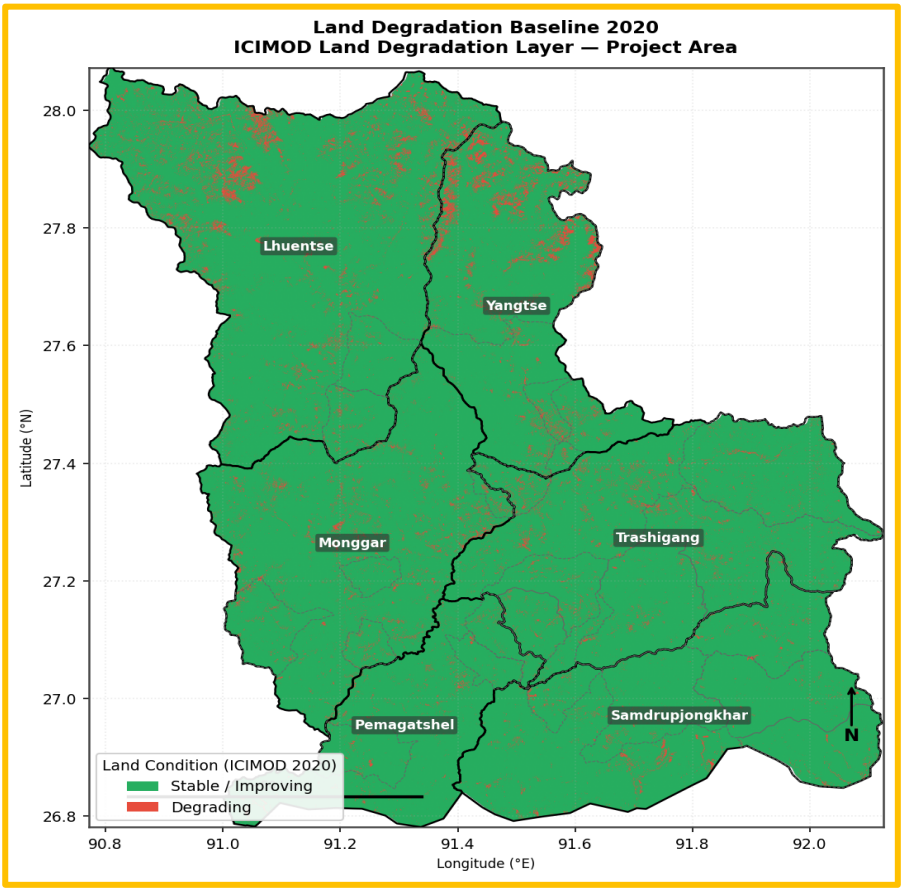


Figure 6.3: Land degradation baseline 2020 (ICIMOD)
(Source: ICIMOD Regional Land Degradation Assessment 2020)
(Spatial distribution of degrading land across the GEF-8 project area, Eastern Bhutan. Total degrading area: 518 km² across 6 Dzongkhags. Highest relative degradation: Trashiyangtse (122 km²) and Lhuentse (179 km²).

[1] *Households may report >1 type; rows aren't mutually exclusive. Unique affected HH = 67* (16.3%)*

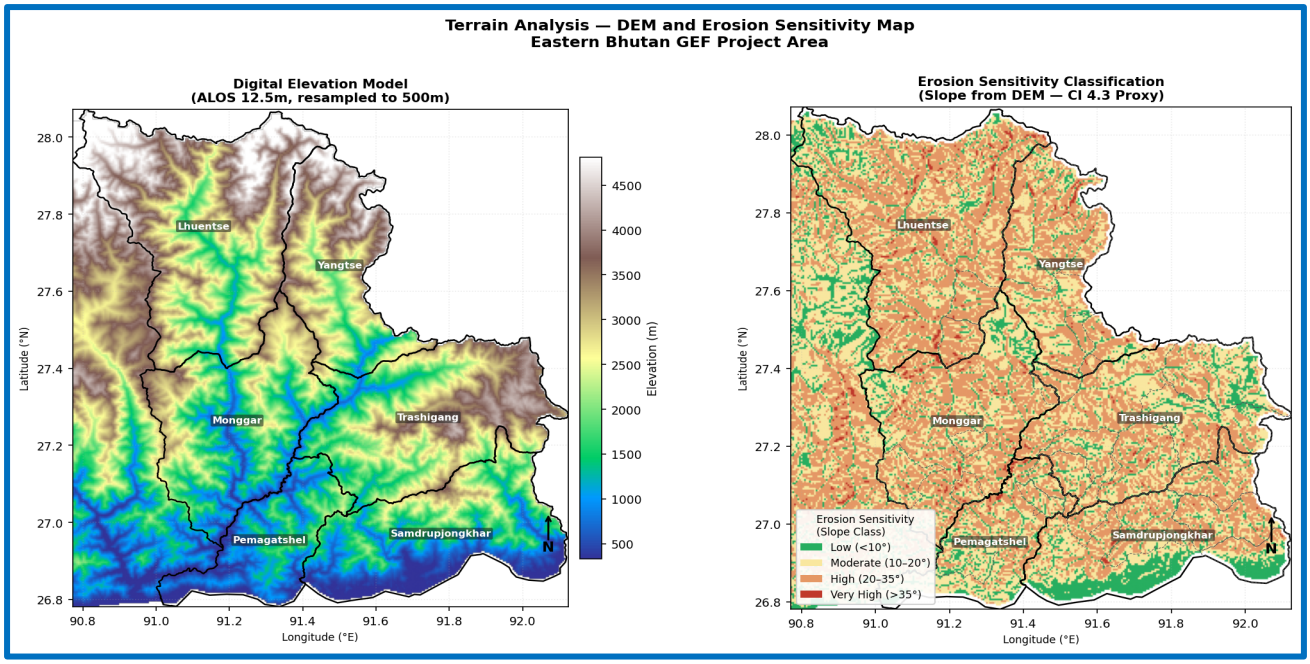


Figure 6.4: Terrain Analysis – DEM and erosion sensitivity classification – GEF8 Project area
(Source: ALOS PALSAR DEM 12.5 m resolution)
(Slope classes: Low (<10°, 14.4%), Moderate (10–20°, 41.9%), High (20–35°, 42.6%), Very High (>35°, 1.1%). Combined High + Very High: 43.7% of project area).

Land Use and Land Cover Change Detection (2010–2020)

A decadal change analysis was conducted by comparing the National Land Commission / DoFPS Land Cover 2010 dataset with the LULC 2020 dataset across the six project Dzongkhags, using raster-based overlay at 500 m resolution. The analysis reveals significant landscape transformation over the 10-year baseline period, with changes driven by both land degradation pressures and climate-induced vegetation zone shifts.

Forest cover declined by 11,003 ha (−1.2%), from 898,469 ha in 2010 to 887,466 ha in 2020, a loss equivalent to approximately 12 times the total surveyed cropland area of the project. Shrubland underwent the most dramatic proportional loss among vegetated classes, declining by 35,125 ha (−43.6%). The transition matrix reveals that 12,000 ha of former shrubland converted to rocky outcrops, confirming active land degradation, while a further 19,000 ha shifted to alpine scrubs, consistent with an upward vegetation zone migration under warming temperatures. Notably, 26,000 ha of former shrubland transitioned to forest, indicating localized natural recovery in some Gewogs, likely in areas with reduced grazing pressure or active community forestry.

The most striking finding is the retreat of snow and glacier cover by 37,910 ha (−58.7%), from 64,593 ha to 26,684 ha, representing a loss of more than half of the cryosphere extent within the project area over a single decade. Of this retreating glacier area, 16,000 ha were converted to rocky outcrops (bare exposed bedrock) and 17,000 ha to alpine scrubs (early vegetation colonization of formerly glaciated terrain). This rate of glacial retreat is consistent with regional projections for the Eastern Himalaya and has direct implications for downstream water security and the rangeland hydrology on which Merak and Sakteng yak pastoralism depends. Rocky outcrops expanded by 21,138 ha (+352%), the highest proportional increase of any class, driven jointly by glacier retreat and shrubland degradation.

Agricultural land showed only marginal net change (+512 ha; +1.5%), consistent with Bhutan's policy of maintaining forest cover above 60% of national territory. Built-up area nearly doubled (+1,180 ha; +98%), reflecting rural settlement expansion and road infrastructure development across the Dzongkhags. These LULC change findings corroborate and spatially contextualize the HH survey data on land degradation perceptions and strengthen the CI 4.3 baseline rationale for SLM intervention.

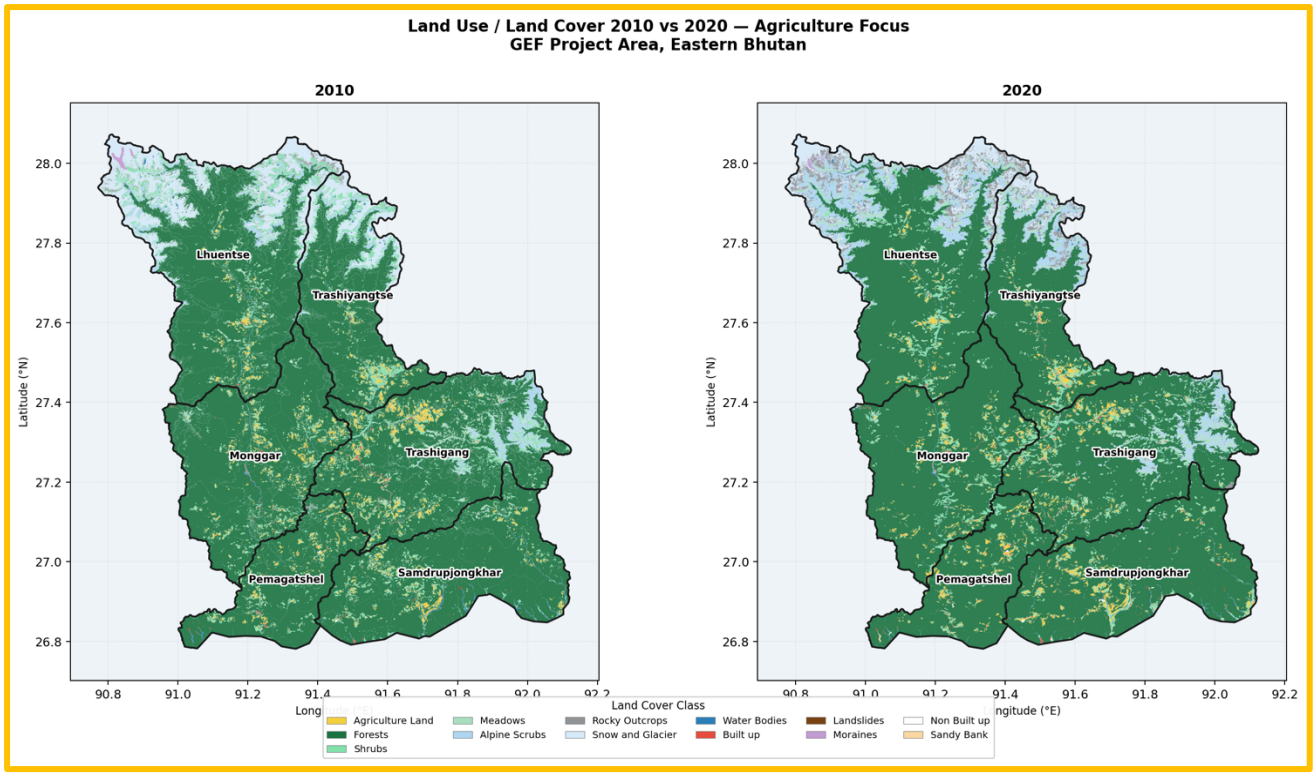


Figure 6.5: LULC change detection 2010-2020

(Source: NLC/DoFPS Bhutan LandCover2010 and LULC2020 datasets; 500 m raster overlay analysis)

(*Spatial distribution of change categories across the GEF project area (left); land cover area comparison by class (top right); net change by class (bottom right).*

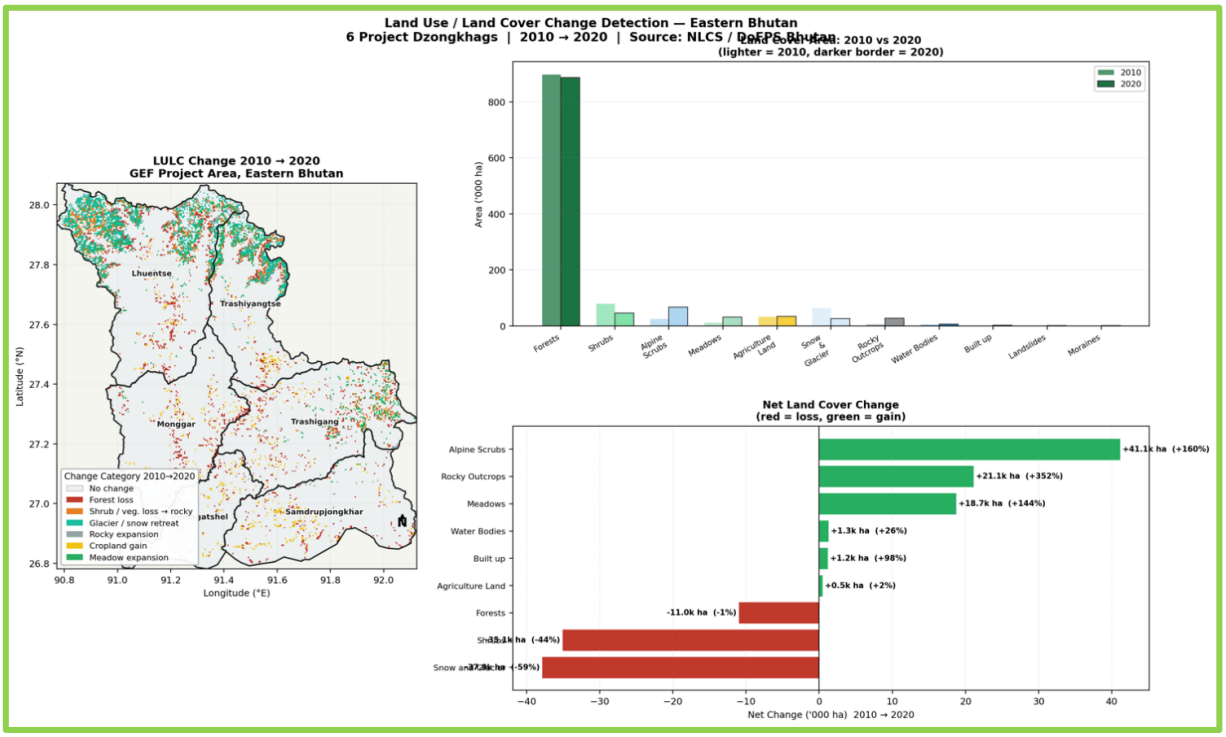


Figure 6.6: LULC change map 2010-2020

The HH survey findings are spatially contextualized through two GIS-derived datasets. The ICIMOD 2020 land degradation assessment identifies Trashiyangtse as the Dzongkhag with the highest proportional degrading area at 9% of its land area (122 km²), followed by Lhuentse at 6% (179 km², the largest absolute degrading area), Mongar at 3.9% (76 km²), Trashigang at 3.5% (77 km²), Samdrup Jongkhar at 2% (42 km²), and Pemagatshel at 2% (22 km²). The aggregate degrading area totals 518 km² (51,792 ha), providing the landscape-scale denominator for LDN baseline tracking.

The DEM-derived erosion sensitivity analysis reveals that the project area's topography is inherently erosion-prone: only 14% has low erosion sensitivity (slopes below 10°), while 43% falls in the high class (20–35°), 42% in the moderate class (10–20°), and 1% in the very high class (above 35°). In aggregate, 85% of the project area carries moderate-to-high inherent erosion risk, confirming that soil conservation is not an optional intervention but a landscape-scale necessity across the entire agricultural and forest landscape of the project area to enhance land productivity, ecosystem resilience, and long-term environmental sustainability.

6.3.2 Adoption of Sustainable Land Management and Climate-Smart Agriculture Practices

Current Adoption of SLM Practices

The adoption of Sustainable Land Management (SLM) practices was assessed based on HH-reported implementation of recognised soil and land conservation measures, including contour hedgerows/live barriers, agroforestry, plantation/woodlots, contour bunds, bench terracing, and other erosion control measures. Among the 412 surveyed HH, 19% (78 HH) reported adopting at least one SLM practice on their agricultural land, covering a directly-measured area of approximately 13.4 ha (**Table 6.6)**.

Vegetative conservation measures were the most commonly adopted practices (**Table 6.6).** Contour hedgerows/live barriers were the most widely adopted, reported by 7% (29 HH) covering a total surveyed area of 4.1 ha. This was followed by agroforestry integration, adopted by 5% (20 HH) across 1.5 ha, and plantation/woodlot establishment, adopted by 4% (17 HH) covering 3.4 ha. Structural and more labour-intensive measures— contour bunds (4%, 15HH), bench terracing (2%,10HH) and physical erosion-control structures (1%, 6HH)— were less commonly adopted, reflecting the higher labour, investment, and technical requirements associated with these interventions.

Overall, the adoption pattern indicates that farmers are more likely to adopt low-cost, vegetation-based conservation measures, while structural soil conservation interventions remain limited.

Table 6.6: Adoption of SLM Practices among surveyed HH (n=412)

SLM Practice	No. of HH Adopting	% of Total HH	Mean Area (ha/HH)	Total Survey Area (ha)
Contour hedgerows / live barriers	29	7	0.14	4.1
Contour bunds / earthworks	15	4	0.10	1.5
Bench terracing	10	2	0.14	1.4
Bioengineering measures	1	0	0.81	0.8
Agroforestry integration	20	5	0.08	1.6
Plantation / woodlot	17	4	0.20	3.4
Physical structures	6	1	0.10	0.6
Other SLM practices	9	2	—	—
Total	78 (unique)	19	—	13.4

(Source: Baseline HH Survey, 2026)

Spatial Distribution and Landscape-Level SLM Baseline

SLM adoption varied considerably across the six surveyed Dzongkhags. Trashigang recorded the highest number of HH adopting SLM practices (49 HH), followed by Samdrup Jongkhar (12 HH), Pemagatshel (7 HH), Lhuentse (5 HH), Trashiyangtse (5 HH), and Mongar (1 HH) (**Table 6.7**). This variation likely reflects

differences in farming systems, agro-ecological conditions, conservation needs, historical exposure to land-management programmes, and the availability of extension support.

Table 6.7: Adoption of SLM practices across six project Dzongkhags(n=412)

Dzongkhag	Sample(n)	HH adopting (n)
Lhuentse	32	5
Mongar	45	1
Pemagatshel	61	7
Samdrup Jongkhar	95	12
Trashigang	123	49
Trashiyangtse	56	4
Overall	**412**	**78**

(Source: Baseline HH Survey, 2026)

The baseline area under SLM management, measured directly from household-reported plot areas, is approximately 13.4 ha across the 78 adopting households (about 15 ha including agro-silvopastoral systems) (**Table 6.8**). This directly-measured area is adopted as the baseline value for GEF Core Indicator 4.3 (area under sustainable land management) and is consistent with the value reported in the Results Framework (**Table 7.1**).

Table 6.8: Reconciled SLM baseline area from the household survey

Indicator	Value
Total surveyed HH	412
HH adopting ≥1 SLM practice	78
HH-level SLM adoption rate	18.9%
Surveyed agricultural land area (cultivated)	511 ha (project-landscape agricultural land ≈ 34,320 ha)
Area under SLM management (HH Survey)	13.4 ha
CI 4.3 baseline — area under SLM management (directly reported, HH Survey)	13.4 ha (≈15 ha incl. agro-silvopastoral)

(Source: Baseline HH Survey, 2026)

SLM Knowledge, Capacity and Future Adoption Potential

Despite the presence of existing SLM practices, formal capacity building and technical support remain limited. Only 9% (35 HH) reported receiving training related to SLM practices, which is considerably lower than the current adoption rate of 19% (**Table 6.9)**. This indicates that many farmers are applying conservation practices through traditional knowledge, local experience, or informal learning rather than through structured technical support programmes. The limited proportion of households receiving formal SLM training (9%) underscores the need to strengthen extension services, farmer-to-farmer learning, and technical support.

A critical gap identified was the low uptake of soil testing, with only 4% of surveyed households reporting having undertaken soil testing. Limited access to soil health assessment services restricts farmers' ability to make informed decisions on nutrient management, potentially contributing to inefficient fertiliser use, declining soil fertility, and increased environmental impacts.

However, there is strong potential for scaling up SLM adoption, as 68% (282 HH) expressed willingness to adopt SLM practices if appropriate support is provided. This indicates that limited adoption is primarily associated with constraints related to technical knowledge, access to inputs, incentives, and extension services rather than lack of interest among farmers.

Table 6.9: SLM knowledge, capacity and adoption potential

Indicator	No. of HH	% of HH
Received SLM-related training	35	9%
Conducted soil testing	17	4%
Willing to adopt SLM practices with support	282	68 %
Not willing to adopt SLM practices	127	31%

(Source: Baseline HH Survey, 2026)

Climate-Smart Agriculture Adoption Index (CSAI)

To complement the assessment of direct SLM interventions, the Climate-Smart Agriculture Adoption Index (CSAI) was calculated to evaluate HH adoption of broader climate-resilient agricultural practices. The CSAI captures adoption of seven practices: soil and water conservation, integrated pest management, organic nutrient management, improved fodder management, agroforestry, water-efficient irrigation (sprinkler/drip), and climate-resilient/local crop varieties.

The overall CSAI value for the 412 surveyed HH was 0.59, indicating a moderate level of adoption of climate-smart agriculture practices. On average, HH adopted approximately 4.1 out of the seven assessed practices. This suggests that while several climate-smart practices are already integrated into farming systems, adoption of the complete range of recommended practices remains limited.

Considerable variation was observed among Dzongkhags. Lhuentse recorded the highest CSAI value (0.82), indicating relatively stronger adoption of climate-smart practices, followed by Pemagatshel (0.62) and Mongar (0.59) (**Table 6.10)**. Trashigang recorded the lowest CSAI (0.53), while other Dzongkhags showed moderate adoption levels.

The findings highlight the need for targeted interventions to promote wider adoption of climate-smart practices, particularly those requiring additional technical knowledge and investment, such as water-efficient irrigation, improved fodder management, agroforestry, and climate-resilient production technologies.

Table 6.10: Climate-smart agriculture adoption index (CSAI) by Dzongkhag

Dzongkhag	CSAI	Adoption Level
Lhuentse	0.821	High
Pemagatshel	0.621	Moderate
Mongar	0.590	Moderate
Samdrup Jongkhar	0.586	Moderate
Trashiyangtse	0.569	Moderate
Trashigang	0.528	Moderate
Overall	**0.590**	**Moderate**

(Source: Baseline HH Survey, 2026)

***Note**: CSAI is calculated as the mean HH adoption score: Σ (number of CSA practices adopted ÷ 7). A value of 1 indicates adoption of all seven CSA practices, while 0 indicates no adoption.*

6.3.3 Soil Fertility Management

Soil fertility management across the project area is largely driven by organic nutrient recycling through farmyard manure (FYM)/organic manure, complemented by limited and variable use of chemical fertilizers (**Table 6.11**). This reflects the predominance of mixed crop–livestock farming systems in eastern Bhutan, where livestock manure remains an important source of nutrients for sustaining agricultural production.

FYM/organic manure was the most widely used soil fertility input, reported by 90% of surveyed HH (370 of 412 HHs). Its use was particularly widespread in Samdrup Jongkhar (96%), Trashigang (94%), Pemagatshel (93%), and Mongar (91%), indicating strong reliance on locally available organic nutrient sources. Although adoption was comparatively lower in Lhuentse (63%) and Trashiyangtse (80%), FYM remained an important component of HH nutrient management practices.

Chemical fertilizer use was comparatively limited, with 33% of HH reporting urea use and 21% reporting Suphala use across the six Dzongkhags. Urea use varied considerably among locations, with the highest prevalence recorded in Lhuentse (97%) and Trashiyangtse (79%), while use was minimal in Mongar (4%) and Samdrup Jongkhar (6%). Suphala use was highest in Trashigang (36%), followed by Pemagatshel (21%) and Trashiyangtse (20%). The use of other chemical fertilizers was negligible, with only a few HH reporting the application of Single Super Phosphate (SSP), and no reported use of Muriate of Potash (MOP).

Crop residue burning remains an important soil fertility concern in some areas. Overall, 31% of surveyed HH reported burning crop residues, with the highest incidence observed in Trashiyangtse (66%), followed by Mongar (40%) and Trashigang (33%). Burning residues results in the loss of organic matter and nutrients that could otherwise contribute to soil fertility improvement through incorporation or composting.

Despite widespread use of organic manure and some application of chemical fertilizers, soil fertility management is rarely supported by soil testing. Only 4% (17 HH) reported having their soil tested during the previous three years to assess soil fertility and guide nutrient management decisions. Soil testing was particularly limited, with no HH in Pemagatshel reporting soil analysis. This indicates that nutrient management decisions are largely based on farmers' experience rather than soil nutrient status, highlighting an important opportunity for promoting evidence-based and site-specific soil fertility management practices.

Overall, the baseline indicates that agricultural soils in the project area are managed primarily through traditional nutrient recycling practices, particularly FYM application, with limited adoption of mineral fertilizers and minimal use of soil diagnostic tools. Strengthening soil testing services, promoting balanced nutrient management, and encouraging sustainable residue management practices will be important pathways for improving soil health and long-term agricultural productivity under the project.

Table 6.11: Soil fertility management practices by Dzongkhag

Dzongkhag	HH sample(n)	Urea use n (%)	Suphala use n (%)	Organic manure use n (%)	Crop residue burning n (%)	Soil tested in last 3 years n (%)
Lhuentse	32	31 (96.9)	2 (6.3)	20 (62.5)	10 (31.3)	2 (6.3)
Mongar	45	2 (4.4)	6 (13.3)	41 (91.1)	18 (40.0)	1 (2.2)
Pemagatshel	61	11 (18.0)	13 (21.3)	57 (93.4)	11 (18.0)	0 (0.0)
S/Jongkhar	95	6 (6.3)	10 (10.5)	91 (95.8)	12 (12.6)	6 (6.3)
Trashigang	123	42 (34.1)	44 (35.8)	116 (94.3)	41 (33.3)	7 (5.7)
Trashiyangtse	56	44 (78.6)	11 (19.6)	45 (80.4)	37 (66.1)	1 (1.8)
Total	**412**	**136 (33.0)**	**86 (20.9)**	**370 (89.8)**	**129 (31.3)**	**17 (4.1)**

(Source: Baseline HH Survey, 2026)

6.3.4 Use of Labour-Saving Farm Machinery

The adoption of labour-saving farm machinery remains an important strategy for reducing labour shortages and improving the efficiency of agricultural operations in the project area. Among the 412 surveyed HH, 59% (241 HH) reported using at least one type of farm machinery, while 53% (220 HH) owned machinery and a further 5% (21 HH) relied on hired equipment (**Table 6.12**). Consequently, 42% of HH had no access to farm machinery and continued to depend primarily on manual labour.

Table 6.12: Farm machinery ownership and use in the priority Gewogs by Dzongkhag

Dzongkhag	Priority Gewogs Surveyed	HH Surveyed	HH Owning Machinery	Ownership (%)	HH Using Machinery *	Use (%)
Lhuentse	Minjey, Tsaenkhar	32	26	81.2	30	93.8
Mongar	Drepong, Jurmed, Narang, Silambi	45	17	37.8	18	40.0
Pemagatshel	Decheling, Nanong, Zobel	61	39	63.9	39	63.9

Samdrup Jongkhar	Gomdar, Langchenphu, Lauri, Martshala, Serthi	95	24	25.3	25	26.3
Trashigang	Kangpar, Khaling, Lumang, Merak, Sakteng, Yangneer	123	59	48.0	74	60.2
Trashiyangtse	Bumdeling, Khamdang, Ramjar	56	55	98.2	55	98.2
Total	**23 priority Gewogs**	**412**	**220**	**53.4**	**241**	**58.5**

(Source: Baseline HH Survey, 2026)
**Includes both owned and hired machinery.*

Although the survey questionnaire included other labour-saving equipment such as sprayers, chainsaws and seeders, respondents reported using only tractors, power tillers and mini power tillers. This indicates that mechanization in the project area remains largely focused on land preparation and primary tillage, with limited adoption of other mechanized farm operations.

As shown in the **Table 6.12**, the level of mechanization varied considerably across the six project Dzongkhags. Trashiyangtse recorded the highest ownership and use of farm machinery (98%), followed by Lhuentse, where 81% of HH owned machinery and 94% used it. Pemagatshel also exhibited relatively high mechanization, with 64% of HH owning and using machinery. In contrast, adoption remained relatively low in Mongar (40%) and Samdrup Jongkhar (26%), while Trashigang showed moderate use (60%), partly due to access to hired machinery.

Mini power tillers were the most commonly owned machines, accounting for 27% of surveyed HH, followed by power tillers (19%). Tractor ownership was relatively limited (4%), while only a small proportion of HH owned more than one type of machinery (**Table 6.13**). The predominance of mini power tillers and power tillers reflects the small, fragmented and sloping agricultural landscapes that characterize eastern Bhutan, where lightweight and manoeuvrable machinery is generally more suitable than larger equipment.

Table 6.13: Farm machinery ownership by type

Machinery type	HH	% of surveyed HH
Mini power tiller	110	26.7
Power tiller	78	18.9
Tractor	16	3.9
Power tiller + Mini power tiller	8	1.9
Tractor + Mini power tiller	7	1.7
Tractor + Power tiller	1	0.2
Hire only	21	5.1
No machinery owned	171	41.5

(Source: Baseline HH Survey, 2026)

Overall, the findings indicate that farm mechanization has gained considerable traction in Trashiyangtse, Lhuentse and Pemagatshel, but remains uneven across the project landscape. Expanding access to appropriate-scale machinery and strengthening community-based machinery hiring services, particularly in Samdrup Jongkhar, Mongar and low-mechanization Gewogs, would help alleviate labour shortages, improve farm productivity and support sustainable agricultural intensification.

6.4 Rangeland Management (CI 3.1)

6.4.1 Access, Livestock Ownership and Utilization

The rangeland survey was conducted among 27 HH in Merak (14 HH) and Sakteng (13 HH) Gewogs of Trashigang Dzongkhag. Of these, 96% (26 HH) reported active access to community rangelands, confirming that pastoralism remains the near-universal livelihood foundation of these communities (**Table 6.14**).

Livestock ownership underscores this dependence: 13 of 14 surveyed HH (93%) in Merak and 8 of 13 (62%) in Sakteng owned yak and/or cattle. Surveyed HH managed 237 yak and 326 local cattle in Merak, and 215 yak and 195 local cattle in Sakteng, with most HH reporting that herd sizes had remained unchanged. These findings are strongly corroborated by IALC 2025 statistics, which record 7,388 yak and zo/zom in Merak and 5,244 in Sakteng — together roughly 97% of the total yak and zo/zom population across all priority dairy Gewogs — alongside 3,295 and 1,965 local cattle respectively. The difference between survey and IALC figures reflects coverage (a sample of livestock-owning HH versus the full Gewog inventory); both confirm that yak, zo/zom, and local cattle remain the foundation of highland livestock systems in the two Gewogs.

Rangeland access and ownership are widespread: 13 HH (93%) in Merak and all surveyed HH (100%) in Sakteng reported registered rangeland holdings. The reported registered/accessed rangeland area totals 1,095 ha (603 ha in Merak and 492 ha in Sakteng), reflecting the holdings of the sampled households. This is a small fraction of the formal cadastral Tsamdro: the NLCS Tsamdro layer records 58,346 ha of registered rangeland title across Trashigang Dzongkhag, of which 56,908 ha lie in Merak and Sakteng alone. The registered Tsamdro base therefore far exceeds the grazing area reported by the surveyed households, indicating that only a portion of the extensive registered rangeland is actively used by any given set of households, and that a participatory rangeland assessment is needed to distinguish actively-managed grazing land from the wider registered extent when establishing and tracking the CI 3.1 baseline. Both Gewogs operate open grazing systems supported by seasonal transhumance, with reported grazing periods of approximately 5 months in Merak and 8 months in Sakteng.

6.4.2 Rangeland Condition and Restoration Practices

Rangeland condition was assessed using a structured three-category scale (**Table 6.14**). Across the 26 HH with rangeland access, 26% (7 HH) rated their primary rangeland as Good, 56% (15 HH) (as Moderate, and 15% (4 HH) as Degraded (one HH did not assess). Disaggregated by Gewog, condition in Merak was rated Good by 6 HH, Moderate by 3, and Degraded by 4, whereas in Sakteng most HH (12) rated condition Moderate, with only 1 reporting Good and none Degraded — indicating a more uniformly moderate status in Sakteng and greater polarisation in Merak, where land degradation was specifically identified as a factor in declining productivity. The Rangeland Condition Index (RCI) is calculated as the weighted mean of condition scores (Good = 1.0, Moderate = 0.5, Degraded = 0.0):

$$RCI = (7 \times 1.0 + 15 \times 0.5 + 4 \times 0.0) / 26 = 14.5 / 26 = 0.558$$

The resulting RCI of 0.558 on a 0–1 scale indicates that community rangelands in Merak and Sakteng are at an intermediate condition status, tilted toward moderate quality. This score constitutes the quantitative baseline against which rangeland condition improvement under project interventions will be tracked. Resource-trend perceptions are mixed: over the past five years, 26% (7 HH) reported that rangeland resources had decreased, 37% (10 HH) (reported no change, and 33% (9 HH) perceived an increase — a divergence that likely reflects spatial heterogeneity in range conditions across herder territories.

Grazing capacity is under evident pressure: 59% (16 HH)— 8 in each Gewog — reported that available pastures were insufficient to meet livestock requirements throughout the annual grazing cycle, 26% (7 HH) rated capacity as moderately sufficient, and only 11% (3 HH) as sufficient (one HH did not assess) (**Table 6.14**).

In response, HHs are actively managing their rangelands: 93% (25 HH) practise fencing (covering 1,432 ha; mean 57.3 ha/HH), 48 % (13 HH) (rotational grazing (1,495 ha), and 44% (12 HH) (reseeding or forage improvement (22.2 ha). Practices differ by Gewog: in Merak, 12 HH reported fencing and 1 reseeding; in Sakteng, improvement practices were more widespread, with all surveyed HH reporting fencing and rotational

grazing and 11 practising reseeding (**Table 6.14**). However, the presence of degraded rangelands and widespread reports of insufficient grazing resources highlight the need to prioritize restoration and sustainable management of degraded areas, including the targeted restoration of 564 ha of rangeland. Existing good management practices, particularly widespread use of fencing and rotational grazing, provide a strong foundation for promoting improved grazing management.

Table 6.14: Rangeland condition, capacity, livestock and management characteristics

Parameter	Merak (n=14)	Sakteng (n=13)	Total (n=27)
HHs owning yak/cattle	13 (93%)	8 (62%)	21 (77.8%)
Yak: surveyed HH (n)	237	215	452
Local cattle: surveyed HH (n)	326	195	521
IALC 2025 yak & zo/zom (Gewog) (n)	7,388	5,244	12,632
IALC 2025 local cattle (Gewog) (n)	3,295	1,965	5,260
HHs with rangeland access/registration (n)	13 (93%)	13 (100%)	26 (96.3%)
Registered / accessed area (ha)	603	492	1,095
Grazing period (months)	5	8	—
Avg migration duration (months)	6.7	4.6	—
Condition: Good (HHs)	6	1	7 (25.9%)
Condition: Moderate (HHs)	3	12	15 (55.6%)
Condition: Degraded (HHs)	4	0	4 (14.8%)
Grazing capacity; Sufficient (HHs)	3	0	3 (11.1%)
Grazing capacity: Mod. Sufficient (HHs)	2	5	7 (25.9%)
Grazing capacity: Insufficient (HHs)	8	8	16 (59.3%)
Fencing: HHs (total area)	12	13	25 (1,432 ha)
Rotational grazing: HHs (total area)	—	13	13 (1,495 ha)
Reseeding; HHs (total area)	1	11	12 (22.2 ha)
Rangeland Condition Index (RCI)	—	—	0.558
Main challenges	Low price; limited buyers	Poor roads; no cold storage	—

(Source: Baseline HH Survey, 2026)

6.4.3 Grazing Management Practices

Three principal rangeland management practices were documented. Rangeland fencing was the most widely practised intervention, reported by 25 households covering a total fenced area of 1,432 ha (mean 57.3 ha/HH). Fencing serves multiple functions in this context for excluding livestock from sensitive vegetation recovery zones, separating seasonal pasture blocks to enable rest periods, and protecting reseeded areas during establishment. Rotational grazing was practised by 13 households managing a total of 1,495 ha under rotation (mean 115.0 ha/HH) which is the largest aggregate area under any single management practice, reflecting the extensive rotational circuits that characterise Brokpa transhumance systems. Pasture reseeding was practised by 12 households on a total of 22.2 ha, representing active investment in rangeland productivity enhancement.

The Core Indicator 3.1 (area of rangelands under improved management) baseline is estimated by integrating the survey-documented management practice areas with the spatial rangeland footprint. The survey documents 1,432 ha under fencing, 1,495 ha under rotational grazing, and 22.2 ha under reseeding. These areas partially overlap, and their combination with the GIS-derived rangeland spatial extent will be refined under the project's rangeland management planning process for Merak and Sakteng.

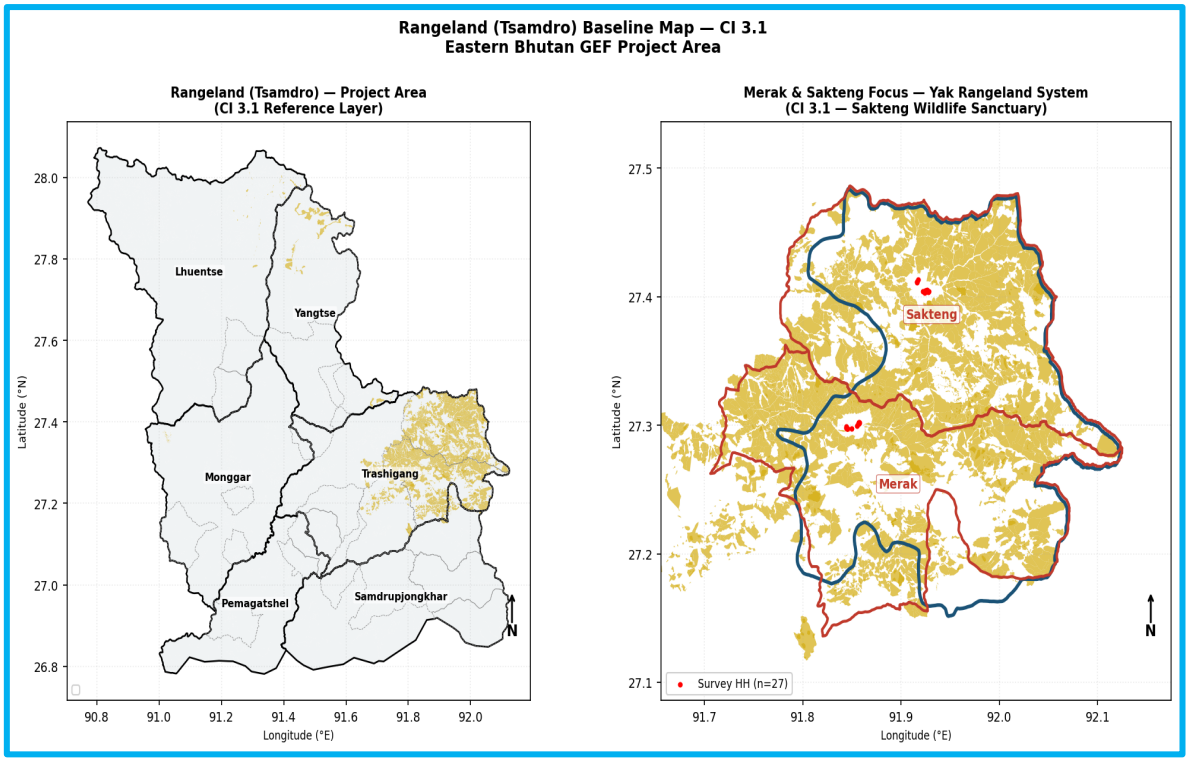


Figure 6.7: Rangeland (Tsamdro) baseline map of Merak and Sakteng, Trashigang Dzongkhag
(Source: NLCS Tsamdro cadastral layer; GEF-8 Baseline Survey GPS data, 2025)
CI 3.1 Baseline: total surveyed area 1,095 ha; RCI = 0.558 (moderate condition). Sakteng Wildlife Sanctuary boundary shown for spatial context.

The map shows that registered Tsamdro is spatially concentrated in the high-altitude Merak and Sakteng landscape, which together hold 56,908 ha (about 98%) of Trashigang's 58,346 ha of cadastral rangeland, much of it within and adjacent to Sakteng Wildlife Sanctuary. Two features are notable. First, the registered Tsamdro extent greatly exceeds the 1,095 ha of grazing reported by surveyed households, indicating that the active use captured by the household survey covers only a small part of the formally titled rangeland. Second, the close overlap between registered rangeland, herding households and the Sanctuary places pastoral land use at the conservation–livelihood interface. For the project this points to two priorities: (i) a participatory rangeland assessment to identify which parts of the extensive registered Tsamdro are actively grazed and managed, so that the CI 3.1 ‘area under improved management’ is measured against genuinely used rangeland; and (ii) planning rangeland-improvement interventions (rotational grazing, reseeding, pasture rest) jointly with Sakteng Wildlife Sanctuary management to reconcile pastoral livelihoods with conservation.

6.4.4 Seasonal Migration and Transhumance

Practice of Seasonal Migration and Transhumance

The baseline assessment found that all livestock-owning HH surveyed in Merak and Sakteng Gewogs under Trashigang Dzongkhag reported practicing seasonal livestock migration. All valid respondents (100%) reported moving their livestock seasonally, with no HH reported a sedentary livestock management system (**Figure 6.8**). This finding confirms that transhumance remains a universal and integral component of pastoral livelihood systems in the study area.

The findings indicate that seasonal livestock migration continues to serve as an important adaptation strategy for managing seasonal variations in climate, forage availability, and grazing resources. By moving livestock between summer and winter pastures, HH optimize the use of rangelands and sustain livestock production in the high-altitude environments of eastern Bhutan. These findings are consistent with the literature, which

describe transhumance as a long -established seasonal grazing system that enables highland communities to adapt to environmental conditions while maintaining their traditional pastoral livelihoods (Moktan et al., 2008; Chand, 2017).

FGD and KII findings reinforce the survey results. In Merak, respondents described a well-established seasonal grazing cycle involving summer, autumn, and winter pastures, with livestock movement extending across neighbouring Gewogs. In Sakteng, key informants reported that seasonal migration remains essential, particularly for HH managing large cattle herds and extensive grazing areas. These qualitative insights align with the literature documenting that transhumance facilitates an important socio-economic institution known as Drukor (or Brukor), a traditional barter system through which Brokpa HH exchange dairy products for staple food grains from valley communities, supported by long-standing reciprocal relationships between highland herders and lowland farming HH (Chand, 2017).

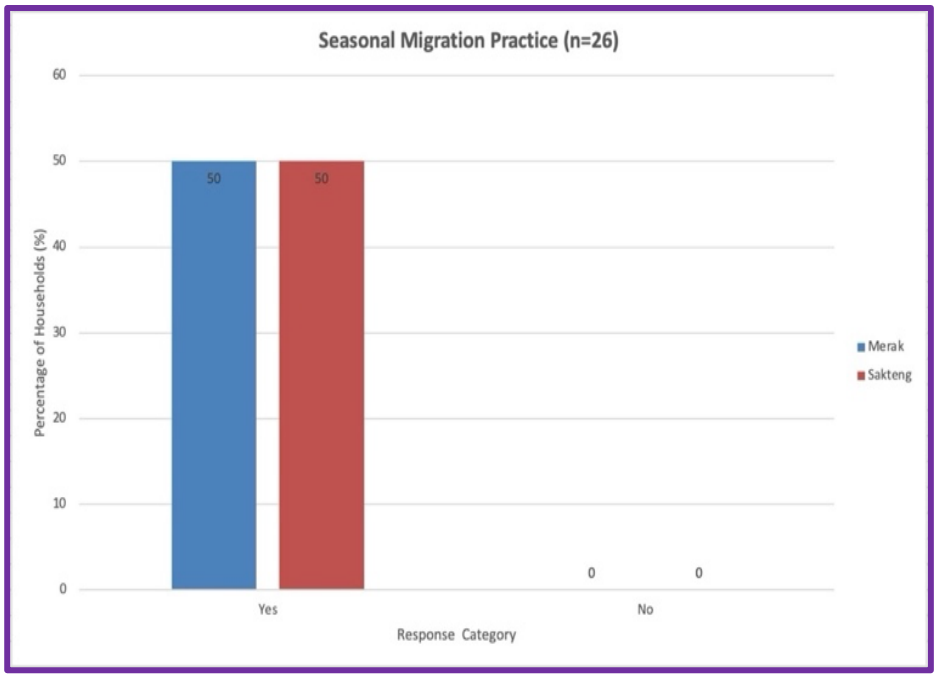


Figure 6.8: Seasonal Livestock Migration in Merak and Sakteng Gewogs, Trashigang Dzongkhag
(Source: Baseline HH Survey, 2026)
Note: *The original sample comprised 27 HH. One HH did not own livestock and was therefore excluded from the analysis, resulting in a valid sample size of 26 livestock-owning HH.*

The universal practice of seasonal migration demonstrates the continued dependence of HH on communal rangelands and migratory grazing routes. It also highlights the importance of sustainable rangeland management, pasture conservation, and secure access to grazing resources for maintaining pastoral livelihoods. At the same time, the literature notes that transhumant systems are increasingly challenged by labour shortages, changing livelihood aspirations, restrictions on traditional grazing rights, market transitions, and climate change (Chand, 2017; Namgay et al., 2021).

The findings clearly demonstrate that seasonal livestock migration remains a defining characteristic of the pastoral production system in Merak and Sakteng Gewogs, underpinning HH livelihoods, traditional knowledge, and sustainable use of mountain rangelands. These findings underscore the importance of interventions that strengthen sustainable rangeland management, maintain access to migratory routes, and enhance the resilience of pastoral communities to emerging environmental and socio-economic challenges. The absence of formal rangeland management plans further highlights the need to develop participatory rangeland management plans that strengthen community stewardship, improve grazing sustainability, and enhance the resilience of pastoral livelihoods.

Duration of Seasonal Livestock Migration

The baseline assessment found that HH practising seasonal migration in Merak and Sakteng migrated for an average of 7 months per year in Merak and 5 months in Sakteng (**Table 6.15**). Migration duration varied considerably, ranging from 1 to 12 months per year, indicating differences in herd size, grazing access, livelihood strategies, and dependence on transhumant pastoralism.

Table 6.15: Distribution of duration of seasonal migration practice in Merak and Sakteng

Category/Statistics	Duration (Months per year)-Overall	Duration (Months per year)-Merak	Duration (Months per year)-Sakteng
Mean	6	7	5
Median	5	5	5
Mode	3	5	3
Maximum	12	12	6
Minimum	1	1	3

(Source: Baseline HH Survey, 2026)
***Note**: The original sample comprised 27 HH. One HH did not own livestock and was therefore excluded from the analysis, resulting in a valid sample size of 26 livestock-owning HH.*

Migration patterns also differed between the two Gewogs (**Figure 6.9**). In Merak, migration patterns were more diverse, ranging from one to twelve months. Nearly one-quarter (23%) of HH migrated for five months, while another 23% practiced migration throughout the year (12 months), indicating continued reliance on mobile livestock production among households. In contrast, Sakteng exhibited a more concentrated pattern, with most HH migrating for either three months (38%) or six months (38%), and the remaining 23% migrating for five months.

The overall median duration of five months suggests that half of the migratory HH spend five months or less in seasonal migration, while the mode of three months suggests that relatively short seasonal movements are the most common practice (**Table 6.15**). However, the presence of HH migrating for up to twelve months demonstrates that transhumant and semi-nomadic livestock production remains an important livelihood system for some pastoral HH.

These findings are consistent with the literature, which describes transhumance in Bhutan as a long-standing adaptation to seasonal variations in temperature, snowfall, and forage availability in high-altitude rangelands (Moktan et al., 2008; Namgay et al., 2013). Studies further note that the duration and timing of migration are influenced by access to grazing rights, climatic conditions, labour availability, and changing livelihood strategies. Emerging challenges—including shrinking grazing areas, labour shortages associated with increasing school enrolment and off-farm employment, and climate variability—are also placing increasing pressure on traditional transhumant systems (Namgay et al., 2013).

The findings clearly confirm that seasonal livestock migration remains a defining feature of pastoral livelihoods in Merak and Sakteng, highlighting the importance of maintaining access to seasonal grazing resources while supporting adaptive rangeland management and the long-term resilience of high-altitude pastoral communities.

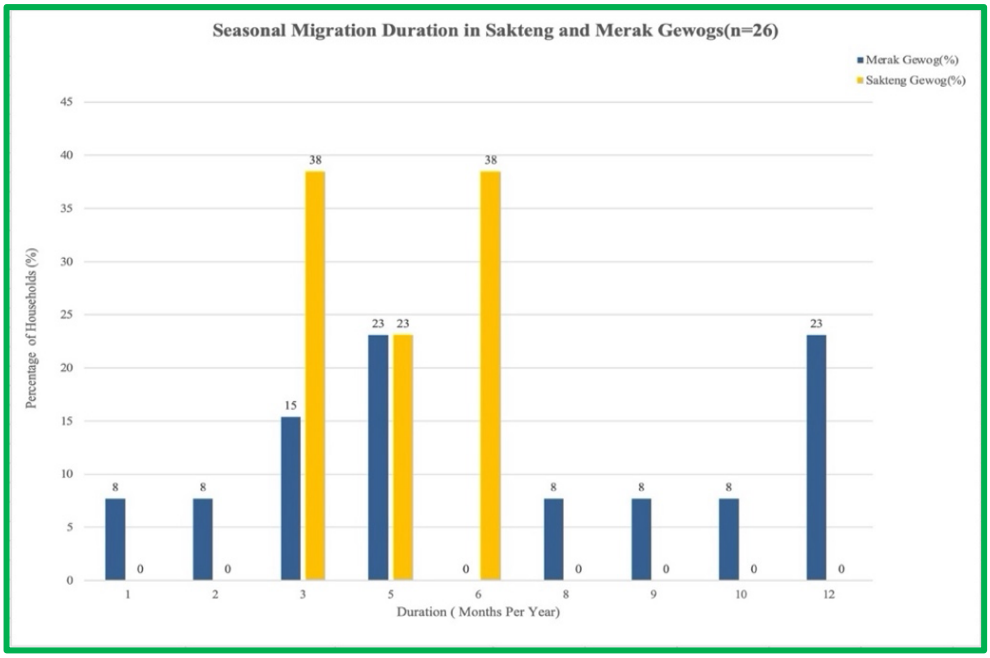


Figure 6.9: Duration of seasonal migration in a Year
(Source: Baseline HH Survey ,2026)
***Note**: The original sample comprised 27 HH. One HH did not own livestock and was therefore excluded from the analysis, resulting in a valid sample size of 26 livestock-owning HH.*

6.4.5 Governance, Constraints and Integrated Synthesis

The combined evidence from HH surveys, FGDs, KIIs, and IALC 2025 confirms that Merak and Sakteng represent distinct but resilient highland pastoral systems, characterised by extensive livestock ownership, seasonal mobility, and dependence on rangeland ecosystems, and together accounting for the majority of yak and *zo/zom* production in the project landscape.

Rangeland governance is in transition. Pasture use was historically regulated through customary institutions such as Che-thram-based grazing arrangements, but changes in land-ownership systems, declining collective management, and socio-economic transformation have weakened traditional governance. While pasture registration has improved clarity over ownership, stakeholders emphasised the need for stronger community-based management to ensure sustainable grazing.

Pasture pressure and feed availability are growing concerns. In Merak, stakeholders reported pasture degradation, shrub encroachment, seasonal feed shortages, and declining suitable grazing areas; the Forest Department supports rangeland improvement through invasive-species removal, prescribed burning, reseeding, and community rehabilitation (~20 ha/year). In Sakteng, conditions were reported to be generally improving, supported by targeted rehabilitation including removal of unpalatable species and prescribed burning (~10 ha of grassland rehabilitated in Tholong). The absence of dedicated rangeland management plans remains a key institutional gap in both Gewogs.

Climate change is an important emerging threat: KIIs reported changing snowfall patterns, reduced snow duration, drying water sources, and rising temperatures that increase heat stress for yaks and reduce the suitability of some traditional grazing areas — pressures that, combined with seasonal fodder shortages, heighten the vulnerability of highland livestock systems. Economic sustainability is further constrained by market and value-chain limitations: although yak butter and cheese enjoy strong demand, HH face challenges in transport, cold storage, product handling, certification, and branding — with low prices the major concern in Merak and poor road connectivity and lack of cold storage in Sakteng. Declining youth participation, driven by the physically demanding nature of yak herding, limited returns, and alternative employment, poses a long-term risk to traditional knowledge and community stewardship.

Overall, the triangulated findings demonstrate that Merak and Sakteng continue to support important and resilient rangeland-based livestock systems, but ones facing increasing pressure from climate change, pasture limitations, market constraints, and socio-economic transition. Strengthening them will require integrated interventions spanning sustainable rangeland management, climate-resilient livestock practices, improved livestock services and market linkages, better dairy-processing infrastructure, and stronger coordination among livestock, forestry, conservation, and local-government institutions.

6.5 Commodity Production Systems

This section presents an integrated assessment of the production systems, performance characteristics, commercialization potential and value chain dynamics of priority crop and livestock commodities across the project Gewogs. The analysis combines quantitative evidence from the GEF-8 Household Survey (2026) and official statistics from the Integrated Agriculture and Livestock Census (NSB, 2025) with qualitative insights generated through Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs).

Each commodity assessment examines three interrelated dimensions. First, production systems and performance analyse the scale and characteristics of production, including household participation, resource endowment, productivity, input use, management practices and degree of commercialization. Second, production context, constraints and opportunities assess the influence of agro-ecological conditions, prevailing farming systems, market dynamics and value chain factors on productivity, profitability, resilience and future development potential. Third, strategic synthesis and development priorities integrate quantitative and qualitative evidence to identify key constraints, comparative advantages, commercialization pathways and priority actions for sustainable and climate-resilient production development.

Together, these assessments establish a comprehensive baseline of the current status, strengths, limitations and future opportunities of priority commodities, providing an evidence base for targeted interventions and investment planning under the GEF-8 project.

6.5.1 Maize Production System

Overview of Maize Production

Maize is the dominant cereal crop in the project area and remains fundamental to household food security, livestock feeding, and mixed crop–livestock production systems in eastern Bhutan. Under the GEF-8 project, maize is prioritized in seven Gewogs: Tsaenkhar (Lhuentse), Nanong (Pemagatshel), Khamdang (Trashiyangtse), Lauri and Serthig (Samdrup Jongkhar), and Lumang and Kangpar (Trashigang).

Integrated Agriculture and Livestock Census (2025) data highlight the regional importance of maize, with 13,233 farming households cultivating 3,087.57 ha and harvesting 2,624.66 ha, in the five priority Dzongkhags, producing 11,437.67 MT at an average productivity of 4,358 kg/ha (NSB, 2025). Production is concentrated in Trashigang and Trashiyangtse, which together account for 57.2% of the total maize production. Trashigang recorded the highest production volume (4,590 MT), while Trashiyangtse achieved the highest average yield (5,467 kg/ha), reflecting favourable agro-ecological conditions and relatively well-established production systems.

Although maize remains an essential staple crop, qualitative evidence indicates that its role is gradually changing. Farmers increasingly allocate land and labour to higher-value enterprises such as vegetables, ginger, cardamom and quinoa, driven by labour shortages, increasing production costs, and persistent human–wildlife conflict (HWC). Consequently, maize is increasingly retained for household consumption and livestock feed rather than commercial sale.

Maize Production Performance in Priority Gewogs

The Baseline Household Survey (2026) indicates that maize remains the most widely cultivated crop among surveyed households, with 140 of the 153 households (92%) reporting maize cultivation. Adoption was universal in Khamdang and Tsaenkhar, highlighting the continued importance of maize within local farming systems (**Table 6.16**).

Surveyed households cultivated a combined area of 44.4 ha and produced 106,810 kg of grain, equivalent to a weighted average yield of 2,406 kg/ha. Yield performance varied considerably across Gewogs, ranging from

1,556 kg/ha in Lauri to 3,435 kg/ha in Kangpar. These differences likely reflect variations in agro-ecological conditions, terrain, soil fertility, crop management practices, and the intensity of production inputs.

Commercialization remains limited. Only 26 households (19% of growers) reported selling maize, mainly in Tsaenkhar (13 households) and Lumang (11 households), where farmgate prices averaged Nu. 35.4/kg and Nu. 32.7/kg, respectively. Across all selling households, the average farmgate price was Nu. 30.8/kg, indicating that maize continues to function primarily as a subsistence crop and an important on-farm feed resource rather than a market-oriented enterprise.

Table 6.16: Maize production by priority Gewog

Priority Gewog	*N* Surveyed	*N* Growers	Total Area (ha)	Total Production (kg)	Yield (kg/ha)	*N* Selling	Price (Nu/kg)
Kangpar	20	18	4.6	15,800	3,435	0	NA
Khamdang	27	27	9.6	21,660	2,256	0	NA
Lauri	21	20	4.5	7,000	1,556	1	30.0
Lumang	29	25	9.4	23,350	2,484	11	32.7
Nanong	21	18	6.3	14,900	2,365	1	25.0
Serthi	15	12	4.2	9,950	2,369	0	NA
Tsaenkhar	20	20	5.8	14,150	2,440	13	35.4
Total/Mean	**153**	**140**	**44.4**	**106,810**	**2,406***	**26**	**30.8**

(Source: Baseline HH Survey ,2026).
** Weighted mean*

Farm Inputs and Mechanization

Farm input use and mechanization vary considerably across project Gewogs, reflecting differences in accessibility, terrain, livestock integration and production systems (**Table 6.17**). Organic manure remains the primary nutrient source, with high adoption across most Gewogs, although application rates differ substantially depending on livestock availability and farm management practices. Chemical fertilizer use is more common in accessible Gewogs with better market connectivity, while pesticide use remains generally limited except in areas experiencing higher pest pressure.

Mechanization and irrigation access are closely linked to terrain, road connectivity and farm accessibility. Accessible Gewogs such as Tsaenkhar, Khamdang, Yangnyer and Bumdeling show higher adoption of farm machinery, whereas remote and highland areas face greater limitations. Similarly, irrigation coverage varies widely, with several rainfed areas remaining vulnerable to climate variability. These patterns highlight the need for context-specific interventions that improve sustainable input management, appropriate mechanization, and climate-resilient water management to enhance productivity and farm sustainability.

Table 6.17: Agriculture input adoption and mechanization across project Gewogs[2]

Gewog	N_HHs (No.)	Chemical Fertilizer (%)	Organic Manure (%)	Mean Organic Manure (kg/HH)	Pesticide (%)	Farm Machinery (%)	Irrigation access (%)
Tsaenkhar	21	100	81	39	91	95	90
Minjey	11	91	27	400	18	55	82
Jurmey	13	8	100	5769	0	31	69
Silambi	13	0	100	474	0	0	0
Drepong	10	0	100	1900	0	40	40
Narang	9	67	56	1524	33	100	89
Decheling	25	16	100	710	60	52	0

[2] *Table 6.15 displays baseline input metrics across all project survey locations for cross-commodity reference. These inputs are not commodity-specific and reflect the broader enabling environment and input intensity of the respective target Gewog.*

Nanong	21	14	95	14944	5	62	24
Zobel	15	60	80	1258	0	87	0
Gomdar	24	38	96	3252	63	13	88
Martshala	24	0	100	1649	0	13	46
Lauri	21	24	91	579	38	48	33
Serthi	15	0	100	20	0	0	13
Langchenphu	11	9	91	264	0	73	100
Lumang	29	45	86	1476	0	14	7
Khaling	24	92	88	747	33	88	100
Yangnyer	23	87	100	2593	9	100	26
Kangpara	20	35	100	921	30	50	50
Merak	14	0	100	40	79	0	0
Sakteng	13	8	100	1000	0	8	8
Khamdang	27	89	96	434	0	100	67
Bumdeling	16	63	100	9384	31	100	56
Ramjar	13	100	23	633	31	92	92

(Source: Baseline HH Survey ,2026)

Maize Production Trends, Constraints and Opportunities

FGDs and KIIs indicate that maize continues to play a critical role in household food security and livestock production, although its importance within local farming systems is gradually declining (**Table 6.18**). Mixed maize–livestock systems remain well established in Tsaenkhar and Kangpar, whereas farmers in Serthi have increasingly shifted land towards higher-value cash crops. In Nanong, rising temperatures have encouraged farmers to move maize cultivation to higher elevations.

Across all study sites, HWC was consistently identified as the most significant production constraint. Crop losses caused by wild pigs, deer, elephants, monkeys and birds substantially reduce yields and discourage investment in maize cultivation. Farmers also reported increasing damage from Fall Armyworm, erratic rainfall, soil erosion, declining soil fertility associated with reduced cattle numbers, and labour shortages.

Commercial development is further constrained by weak market incentives. The widespread availability of imported rice has reduced local demand for maize, while the absence of aggregation systems, limited processing facilities, and inadequate storage infrastructure discourage surplus production and value addition.

Table 6.18: Qualitative findings on Maize Systems (FGDs and KIIs)

Structural Theme	Core Findings
Production System	Predominantly subsistence-based mixed farming; commercialization is limited except in Tsaenkhar. Serthig has systematically shifted land to high-value cash crops.
Drivers of Change	Easy access to imported rice, labour shortages, declining livestock numbers, and climate change are accelerating the transition away from staple maize.
Land & Inputs	FYM is the main nutrient source; synthetic fertilizer use is erratic. Declining livestock herds directly degrade soil organic fertility.
Primary Constraints	Severe HWC, Fall Armyworm, lack of quality seeds/fertilizers, fragmented land, and weak extension coverage.
Market Constraints	Underdeveloped value chains, lack of local milling/processing, minimal storage, and cheap imported rice disincentivize surplus production.
Gender & Labour	Heavy reliance on family labour. Women drive daily farm operations and management, whereas youth participation is minimal.
Sustainability	Strong farmer preference for organic management, Climate-Smart Agriculture (CSA), and drought/pest-resilient seed varieties.

Strategic Needs	Quality seed distribution, HWC mitigation fencing, processing/milling infrastructure, and formal aggregation mechanisms.

(Source: Focus Group Discussions and Key Informant Interviews ,2026)

Integrated Synthesis: Maize Production System

Maize remains the principal food-security crop across the project area, but its commercial importance is gradually declining. While household participation is high, productivity in the surveyed Gewogs (2,406 kg/ha) remains substantially below the regional IALC average (4,358 kg/ha), indicating considerable scope for productivity improvement. Survey findings and qualitative evidence suggest that this yield gap is associated with persistent HWC, Fall Armyworm infestation, labour shortages, declining soil fertility, and relatively low adoption of improved production technologies.

The survey also highlights the predominantly subsistence nature of maize production. More than four-fifths of maize-growing households retained their harvest for household consumption and livestock feed, with only a small proportion participating in the market. Improving productivity alone is therefore unlikely to stimulate commercialization unless accompanied by measures that reduce production risks, improve post-harvest handling, and strengthen market incentives.

Accordingly, project interventions should focus on four complementary areas: (i) improving access to high-yielding and climate-resilient maize varieties together with integrated soil fertility improvement and integrated pest and disease management; (ii) reducing HWC through appropriate fencing and community-based mitigation measures; (iii) strengthening post-harvest processing and storage facilities to reduce losses and improve product quality; and (iv) developing producer aggregation and market linkages to create viable commercial outlets for surplus grain.

6.5.2 Buckwheat Production System

Overview of Buckwheat Production

Buckwheat is a resilient, low-input crop that is well adapted to the high-altitude mountain farming systems of eastern Bhutan. Its ability to perform under marginal growing conditions, together with increasing consumer demand for healthy, gluten-free and organic food products, has enhanced its potential as a niche commercial crop. Under the GEF-8 project, buckwheat production is prioritized in Silambi (Mongar), Gomdar (Samdrup Jongkhar) and Bumdeling (Trashiyangtse) Gewogs.

The census data (IALC, 2025) indicate that buckwheat production remains geographically concentrated within these priority Dzongkhags. A total of 1,146 households cultivated 155.32 ha, harvesting 137.87 ha to produce 124,550 kg of grain at an average yield of 903 kg/ha. Samdrup Jongkhar accounted for more than 70% of total production, while Mongar achieved the highest average productivity (1,027 kg/ha), reflecting favourable production conditions and stronger market engagement (NSB, 2025).

Unlike maize, buckwheat is primarily cultivated as a commercial crop, particularly where farmer groups and market linkages have been established. Nevertheless, production remains limited by labour-intensive processing, fragmented production volumes and inadequate value addition

Buckwheat Production Performance in Priority Gewogs

The Baseline Household Survey (2026) recorded buckwheat cultivation in 21 of the 53 surveyed households (40%), with production concentrated in Gomdar (12 growers) and Silambi (7 growers), while only two households cultivated buckwheat in Bumdeling (**Table 6.19**).

Surveyed households cultivated 3.1 ha and produced 3,414 kg of grain, giving a weighted average yield of 1,101 kg/ha, which exceeds the regional IALC average. Yield variation among the three priority Gewogs was minimal, ranging from 1,112 kg/ha in Silambi to 1,123 kg/ha in Bumdeling, indicating relatively stable crop performance across production areas.

Buckwheat was the most commercially oriented cereal crop recorded during the survey. All growers sold their harvest, with an average farmgate price of Nu. 53.9/kg. Gomdar achieved the highest average price (Nu. 66.7/kg), reflecting the presence of organized farmer groups and established marketing arrangements.

Table 6.19: Buckwheat production by priority Gewog

Priority Gewog	*N* Surveyed	*N* Growers	Total Area (ha)	Total Production (kg)	Yield (kg/ha)	*N* Selling	Price (Nu/kg)
Bumdeling	16	2	0.1	100	1,123	2	50.0
Gomdar	24	12	1.5	1,644	1,119	12	66.7
Silambi	13	7	1.5	1,670	1,112	7	45.0
Total/Mean	**53**	**21**	**3.1**	**3,414**	**1,101***	**21**	**53.9**

(Source: Baseline HH Survey, 2026). * *Weighted mean*

Farm Inputs and Mechanization

Buckwheat continues to be produced under predominantly traditional, low-input production systems. Organic manure is widely used across all production areas, although application rates differ according to livestock ownership (**Table 6.17**). Chemical fertilizer and pesticide use remain limited and are largely confined to Gomdar and Bumdeling, whereas production in Silambi relies almost entirely on organic nutrient sources.

Mechanization varies considerably across the three Gewogs. Bumdeling has good access to power tillers, while cultivation in Gomdar and Silambi Gewogs remains largely manual because of steep terrain and fragmented landholdings. Post-harvest operations, including threshing and dehulling, are almost entirely manual throughout the project area.

Buckwheat Production Trends, Constraints, and Opportunities

The qualitative assessment (FGDs and KIIs) indicates growing commercial interest in buckwheat, driven by increasing domestic demand for healthy food products and emerging export opportunities (**Table 6.20**). Farmers recognize buckwheat as a profitable alternative for high-altitude areas where agriculture production options are limited.

Gomdar represents the most advanced production system within the project area. Four organic buckwheat cooperatives operate across Chidungkhar, Berzor, Denchi and Khoryer Chiwogs, supplying approximately 5 MT of raw grain annually to Japan through Regional Agricultural and Marketing Cooperative Office (RAMCO) in addition to domestic supply. This experience demonstrates the benefits of organized production, collective marketing and some level of value addition.

Despite this potential, expansion remains constrained by labour-intensive processing, limited mechanization, fragmented production among smallholders, and inadequate aggregation. Farmers continue to rely on traditional threshing and dehulling methods, which reduce processing efficiency, increase labour requirements and limit the ability to supply consistent, high-quality products to local and premium markets.

Table 6.20: Qualitative findings on buckwheat systems (FGDs & KIIs)

Structural Theme	Core Findings
Production Profile	Highly resilient, low-input niche cereal. Gomdar serves as the commercial flagship (~250 HHs, 200 acres, ~150 MT/year output).
Commercial Drivers	Strong market alignment with domestic and export demand for organic, gluten-free, and health foods.
Value Addition	Primary processing is limited to basic flour milling; emerging opportunities exist in noodles, tea, and bakery products. Export channels to Japan exist via RAMCO.
Market & Value Chain	High market demand, but growth is hindered by fragmented volume, informal aggregation, and lack of branding.
Key Constraints	Extreme labour shortages, steep terrain limiting mechanization, lack of modern dehullers/threshers, and absence of formal organic certification.
Sustainability	Excellent climate tolerance, low pest/HWC vulnerability, and organic nutrient reliance make it an ideal eco-friendly crop.
Support Priorities	Small-scale mechanized threshers, modern dehulling mills, organic group certification, packaging, and institutional buyer contracts.

(Source: Focus Group Discussions and Key Informant Interviews ,2026)

Integrated Synthesis: Buckwheat Production

Buckwheat is the most commercially oriented cereal crop within the project portfolio. Although production occupies relatively small areas, all surveyed growers marketed their harvest and received substantially higher prices than maize producers, demonstrating strong market demand and attractive income potential.

Survey results also indicate that localized productivity (1,101 kg/ha) exceeds the regional IALC average (903 kg/ha), suggesting that existing production practices are technically sound where farmers receive adequate support. However, qualitative evidence consistently identifies post-harvest processing as the principal constraint limiting further expansion. Manual threshing, dehulling and packaging increase production costs, reduce processing efficiency and constrain access to premium domestic and export markets.

Future interventions should therefore focus on strengthening the commercial value chain rather than expanding production alone. Priority investments include village-level processing facilities, small-scale mechanization for post-harvest operations, producer organization, organic certification, product branding and stronger contractual market linkages with institutional and export buyers. These interventions would enable producers to capture greater value while maintaining buckwheat's comparative advantage as a high-value niche crop.

6.5.3 Quinoa Production System

Overview of Quinoa Production

Quinoa is an emerging climate-resilient crop with considerable potential to diversify farming systems and strengthen household nutrition in eastern Bhutan. Its tolerance to drought, frost and marginal soils makes it well suited to the region's changing climatic conditions, while increasing consumer demand for nutritious, gluten-free grains has created new market opportunities. Under the GEF-8 project, quinoa is prioritized in Drepong, Zobel, Bumdeling, Langchenphu, Lauri, and Serthi Gewogs. According to IALC (2025) data, quinoa production remains at an early stage of adoption across eastern Bhutan. A total of 248 growers cultivated 11.56 ha, of which 9.62 ha was harvested, producing 9,200 kg at an average yield of 956 kg/ha across the five priority Dzongkhags (NSB, 2025). Production is highly concentrated in Trashiyangtse and Mongar, which accounted for 4,580 kg (50%) and 4,120 kg (45 %) of total production, respectively, together contributing 95% of the total production. Trashiyangtse Dzongkhag recorded the highest productivity (1,071 kg/ha), followed by Mongar Dzongkhag (861 kg/ha) (NSB, 2025). Although current production volumes remain limited, quinoa has attracted increasing interest due to its adaptability to marginal environments and potential as a high-value specialty crop.

Quinoa Production Performance in Priority Gewogs

The Baseline Household Survey (2026) indicates that quinoa adoption remains at an early adoption stage among surveyed households, with only 11 out of 88 households (13%) reporting production (**Table 6.21**). Cultivation was concentrated in Bumdeling and Zobel, with Bumdeling accounting for the majority of production (1.7 ha cultivated area and 1,440 kg production). In contrast, adoption in Zobel was limited to only two households, reflecting the emerging nature of quinoa production within the surveyed Gewogs.

Production areas were generally small, highlighting the experimental and learning-oriented nature of quinoa cultivation among farmers. The overall weighted average yield was 685 kg/ha, which is higher than the national average reported under IALC 2025, suggesting that quinoa has potential for improved performance under suitable local agro-ecological conditions and with appropriate crop management. However, substantial yield variation was observed between Gewogs, with Bumdeling achieving considerably higher productivity (828 kg/ha) compared with Zobel (225 kg/ha), indicating the influence of management practices, production environment, and farmer experience.

Despite the limited production scale, quinoa demonstrates emerging commercial potential. All producing households reported selling their harvest, with an average farmgate price of Nu. 92.8/kg, reflecting its higher market value compared with conventional cereal crops. However, the current production volume remains too small to support consistent aggregation, market supply, and value chain development. Scaling up production

will require targeted technical support, access to quality seed, improved production practices, and strengthened market linkages to encourage wider adoption among farmers.

Table 6.21: Quinoa production by priority Gewogs

Priority Gewog	*N* Surveyed	*N* Growers	Total Area (ha)	Total Production (kg)	Yield (kg/ha)	*N* Selling	Price (Nu/kg)
Bumdeling	16	9	1.7	1,440	828	9	105.6
Drepong	10	0	-	-	-	-	-
Langchenphu	11	0	-	-	-	-	-
Lauri	21	0	-	-	-	-	-
Serthi	15	0	-	-	-	-	-
Zobel	15	2	0.6	135	225	2	80.0
Total/Mean	**88**	**11**	**2.3**	**1,575**	685*	**11**	**92.8**

(Source: Baseline HH Survey, 2026). * *Weighted mean*

Farm Inputs and Mechanization

Quinoa is generally produced under low-input management systems similar to those used for buckwheat (**Table 6.17**). Organic manure remains the primary nutrient source, while the use of chemical fertilizers and pesticides is limited. Most field operations, including sowing, weeding and harvesting, are carried out manually because of the small production scale and fragmented landholdings. Mechanization remains minimal, particularly for harvesting and post-harvest processing.

Quinoa Production Trends, Constraints and Opportunities

FGDs and KIIs indicate growing farmer interest in quinoa because of its resilience to climatic variability, relatively low production risks and strong market demand (**Table 6.22**). Farmers recognize quinoa as a promising diversification option that complements existing cereal-based farming systems while offering higher economic returns than many traditional grains.

Despite this potential, expansion remains constrained by several technical and market-related challenges. Limited access to quality seed, inadequate technical knowledge on crop management, labour-intensive harvesting and processing, and the absence of specialized post-harvest equipment continue to restrict production. Small and scattered production volumes further limit collective marketing and discourage private-sector investment in processing and value addition.

Market awareness also remains limited. While consumer demand is increasing, producers have few opportunities to access premium niche markets because of weak branding and lack of organic certification, inconsistent product quality and limited market promotion.

Table 6.22: Qualitative findings on quinoa production systems (FGDS & KIIs)

Structural Theme	Core Findings
Development Stage	Emerging commercial crop. Successful establishment in Bumdeling; abandoned or dormant in Drepong, Lauri, and Serthig due to early technical failures.
Production Potential	Excellent agro-ecological adaptation, minimal pest/HWC pressure, and superior drought tolerance.
Agronomic Constraints	High failure rate during germination caused by poor seed quality, improper broad-sowing depth, and inadequate seedbed preparation.
Input & Extension Support	High reliance on FYM; extension follow-up on specialized quinoa agronomy (line sowing, weeding) has been sporadic.
Climate & Pest Risks	Quinoa has low pest and disease pressure but faces occasional wildlife damage and climate-related production variability.
Post-Harvest & Value Addition	Lack of threshing, cleaning, grading, and processing facilities limits efficiency and value addition. Produce is mostly sold as raw grain.

Market Potential	Excellent market value (farmgate Nu. 92.8/kg; retail up to Nu. 200/kg). Demand exceeds local supply when processed.
Development Priorities	Strengthen seed systems, practical training, mechanization, processing infrastructure, extension support, and market linkages to scale up production.

(Source: Focus Group Discussions and Key Informant Interviews ,2026)

Integrated Synthesis on Quinoa Production

Quinoa has strong potential to become a high-value climate-smart crop within the project area but remains at an early stage of adoption. Survey findings demonstrate that participating farmers are achieving satisfactory yields and favourable market prices despite cultivating only small areas. This suggests that the principal constraints to expansion are not agronomic but institutional and market-related.

The combined survey and qualitative evidence indicate that future growth will depend on strengthening the entire value chain rather than simply increasing production. Expanding access to quality seed, improving farmer technical capacity, introducing appropriate post-harvest technologies, and strengthening producer organizations will be essential for increasing production efficiency and ensuring consistent product quality. Equally important will be the development of branding, product promotion, organic certification, and market partnerships that enable producers to access premium domestic and export markets.

Given its nutritional value, climate resilience and strong market prospects, quinoa offers an important opportunity to diversify farming systems while improving household income and resilience. Strategic project support should therefore focus on developing quinoa as a specialized commercial enterprise integrated with existing cereal production systems rather than as a replacement for traditional staple crops.

6.5.4 Potato Production

Overview of Potato Production

Potato is one of the most important commercial crops in eastern Bhutan, providing a major source of cash income for farming households in the temperate and high-altitude production areas. Strong domestic demand, established market channels and favourable agro-climatic conditions have enabled potato to evolve from a subsistence crop into a market-oriented enterprise. Under the GEF-8 project, potato production is prioritized in prioritized in Tsaenkhar, Narang, Nanong, Zobel, Langchenphu, Martshala, Lauri and Yangneer Gewogs.

The IALC (2025) data demonstrate the importance of potato as a major commercial crop across the five priority Dzongkhags. A total of 12,722 households cultivated 1,209.48 ha, of which 1,097.04 ha was harvested, producing 9.46 million kg of tubers at an average yield of 8,623 kg/ha. Production is highly concentrated in Trashigang and Mongar, which contributed 4.80 million kg (50.7%) and 3.17 million kg (33.5%), respectively, together accounting for 84.3% of regional production. Trashigang recorded the highest productivity (10,929 kg/ha), followed by Mongar (7,468 kg/ha), reflecting differences in production environments, access to quality seed, crop management practices and market connectivity. The substantial production base and strong market orientation indicate potato's continued importance as a commercial crop in eastern Bhutan.

Despite its established commercial status, potato production faces increasing challenges associated with climate variability, production costs, pests and diseases, and labour shortages. Maintaining competitiveness will therefore depend on improving productivity, product quality and market efficiency.

Potato Production Performance in Priority Gewogs

The Baseline Household Survey (2026) confirms that potato is an important crop across the priority Gewogs, with 103 of 143 surveyed households (72%) engaged in cultivation (**Table 6.23**). Adoption was highest in Yangneer, where all surveyed households cultivated potato, while participation was also high in Narang (89%), Lauri (81%), Tsaenkhar (70.0%), Nanong (67%), and Zobel (80%), underscoring the crop's significance as both a food and cash crop in these production systems.

Surveyed households cultivated a combined 20.5 ha, producing 110,560 kg of potatoes with a weighted average yield of 5,393 kg/ha. Production performance varied considerably among Gewogs. Zobel recorded the highest yield

(9,125 kg/ha), followed by Langchenphu (7,875 kg/ha) and Yangneer (7,770 kg/ha), whereas lower yields were observed in Lauri (2,225 kg/ha), Tsaenkhar (2,692 kg/ha), and Nanong (3,032 kg/ha). These differences likely reflect variations in seed quality, soil fertility, altitude, crop management practices, pest and disease incidence, and weather conditions.

Potato is also one of the most commercialized commodities in the project area. Of the 103 producing households, 76 households (74%) sold part of their harvest, indicating strong market orientation. Farmgate prices averaged Nu. 24.8/kg, ranging from Nu. 14.5/kg in Langchenphu to Nu. 35.6/kg in Martshala, reflecting differences in harvest timing, tuber quality, market access, and seasonal demand. Despite its strong commercial potential, fluctuating market prices and rising production costs continue to constrain farm profitability, highlighting the need for improved seed systems, productivity-enhancing technologies, and stronger market linkages.

Table 6.23: Potato production by priority Gewog

Priority Gewog	*N* Surveyed	*N* Growers	Total Area (ha)	Total Production (kg)	Yield (kg/ha)	*N* Selling	Price (Nu/kg)
Langchenphu	11	4	0.40	3,150	7,875	2	14.5
Lauri	21	17	1.60	3,560	2,225	5	34.0
Martshala	24	12	1.50	7,640	5,093	9	35.6
Nanong	21	14	4.10	12,430	3,032	9	22.3
Narang	9	8	2.90	9,800	3,379	8	19.5
Tsaenkhar	20	14	1.80	4,845	2,692	10	30.5
Yangneer	22	22	4.20	32,635	7,770	21	21.9
Zobel	15	12	4.00	36,500	9,125	12	20.0
Total/Mean	**143**	**103**	**20.50**	**110,560**	**5,393***	**76**	**24.8**

(Source: Baseline HH Survey, 2026). * *Weighted mean*

Farm Inputs and Mechanization

Potato production is relatively input-intensive compared with the cereal crops. Organic manure remains an important component of soil fertility management, complemented by chemical fertilizers in most production areas (**Table 6.17).** Pesticide use is also more common because of the higher incidence of late blight and other pests and diseases. Mechanization has expanded in accessible areas through the use of power tillers and other machinery for land preparation, although planting, harvesting and grading remain largely labour-intensive.

Potato Production Trends, Constraints and Opportunities

The qualitative assessment (FGDs and KIIs) indicates that potato remains the principal cash crop in many highland communities because of its established markets and relatively reliable financial returns (**Table 6.24**). However, farmers consistently reported that production has become increasingly challenging as input prices, labour costs and transportation expenses continue to rise.

Production is further constrained by declining seed quality, limited access to certified seed tubers, increasing incidence of late blight and other diseases, erratic rainfall, and HWC in some production areas. Labour shortages associated with rural outmigration have increased dependence on hired labour, further reducing profitability. Farmers also highlighted the absence of adequate storage facilities, forcing immediate sales after harvest when market prices are often lowest.

Despite these constraints, potato continues to offer strong opportunities for commercial growth. Existing marketing networks provide a solid foundation for further development through productivity improvement, better post-harvest management and value addition.

Table 6.24: Qualitative Findings on Potato Systems (FGDs & KIIs)

Structural Theme	Core Findings
Production Profile	Dominant commercial driver in high/mid-altitude Gewogs (Yangneer, Zobel, Narang); subsistence-focused in remote zones.
Key Constraints	Limited access to quality seed potatoes, irrigation, technical support, pest and disease management, and climate-related risks constrain productivity.

Market Challenges	Severe price volatility at border auctions, heavy commission agent charges, high freight costs, and distress selling due to zero cold storage.
Sustainability	Wildlife damage, climate variability, and declining labour availability affect production expansion.
Priority Interventions	Strengthen seed systems, irrigation, extension services, crop protection, storage, mechanization, and market linkages to improve commercialization.

(Source: Focus Group Discussions and Key Informant Interviews ,2026)

Integrated Synthesis: Potato Production System

Potato is the most mature commercial crop within the GEF-8 project portfolio, combining high household participation, established market linkages and strong income-generating potential. Unlike maize and other staple crops, production is clearly market-oriented, with most growers selling a substantial proportion of their harvest.

Nevertheless, survey and qualitative findings indicate that sustaining profitability will depend more on improving production efficiency than on expanding cultivated area. Rising input costs, declining seed quality, pest and disease pressure, labour shortages and limited storage infrastructure are progressively reducing production margins and increasing production risks.

Future interventions should therefore prioritize productivity enhancement and value-chain strengthening. Improving access to certified seed, promoting integrated pest and disease management, strengthening soil fertility management, expanding appropriate mechanization, and improving storage and post-harvest handling will help reduce production losses and stabilize farmer incomes. At the same time, strengthening producer organizations and market coordination would improve bargaining power and reduce the effects of seasonal price fluctuations, enabling potato to remain one of the project's most competitive commercial commodities.

6.5.5 Vegetable Production System

Overview of Vegetable Production

Vegetable cultivation is among the fastest-growing agricultural enterprises in eastern Bhutan, offering high economic returns from relatively small landholdings while contributing significantly to household nutrition and income diversification. Unlike cereal crops, vegetable production is largely market-oriented and includes a diverse range of commodities. Under the GEF-8 project, vegetable production (as chilli, beans, tomato, broccoli, cauliflower and asparagus) is prioritized in Ramjar (Trashiyangtse), Kangpar (Trashigang), Nanong (Pemagatshel), Serthig (Samdrup Jongkhar) and Khaling (Trashigang) Gewogs.

Based on IALC (2025), vegetable production is well established across the five priority Dzongkhags, with 40,135 growers cultivating 833.82 ha and producing 2,904.62 MT of vegetables at an average yield of 3,483 kg/ha (NSB, 2025). Production is concentrated in areas with favourable road connectivity, irrigation access and proximity to urban markets, which support commercial-oriented vegetable farming. Among the major vegetable commodities, chilli is the dominant enterprise, involving 14,318 growers and contributing 1,701.76 MT, followed by beans (591.01 MT), broccoli (309.15 MT), cauliflower (257.32 MT), tomato, and asparagus (18.07 MT) (NSB, 2025). Trashigang and Mongar are the main production hubs, contributing 1,030 MT and 792.57 MT, respectively. Given their higher returns per unit area compared with staple crops, vegetables represent an important pathway for enhancing household income, market participation and agricultural commercialization in eastern Bhutan.

Despite this strong commercial potential, production remains constrained by seasonal market gluts, labour shortages, HWC and post-harvest losses, resulting in considerable variability in farm income.

Vegetable Production Performance in Priority Gewogs

The Baseline Household Survey (2026) shows widespread adoption of vegetable cultivation across the priority Gewogs, although production systems differ according to local agro-ecological conditions and market opportunities (**Table 6.25**). Chilli, beans and tomato dominate production in the warmer low- and mid-altitude Gewogs, while broccoli, cauliflower and asparagus are concentrated in cooler production environments.

Surveyed households cultivated relatively small areas but achieved the highest productivity per unit area among all commodities assessed under the project. Estimated yields consistently exceeded those of cereal crops, reflecting the intensive management practices associated with commercial vegetable production. Production was primarily market-oriented, with most growers selling a substantial proportion of their harvest through local traders, roadside markets and regional wholesale markets.

Nevertheless, commercialization remains constrained by inconsistent product quality, seasonal oversupply and fluctuating farmgate prices. Farmers frequently reported reduced returns during peak harvest periods when local markets become saturated.

Table 6.25: Vegetable production by priority Gewog

Priority Gewog	*N* Surveyed	*N* Growers	Total Area (ha)	Total Production (kg)	Yield (kg/ha)
Kangpar	20	16	1.4	13,406	9,576
Nanong	21	10	0.4	3,639	9,098
Narang	9	8	0.1	1,313	13,130
Ramjar	13	2	0.02	154	7,700
Serthi	15	6	0.2	1,759	8,795
Total / Mean	**78**	**42**	**2.12**	**20,271**	**9,562***

(Source: Baseline HH Survey, 2026) * *Weighted mean*

Farm Inputs and Mechanization

Vegetable production is one of the most input-intensive enterprise within the project area. Most growers apply organic manure together with chemical fertilizers to sustain high crop productivity, while pesticide use is considerably higher than for other commodities because of greater pest and disease pressure (**Table 6.17**). Access to irrigation is a key determinant of production intensity, enabling multiple cropping cycles each year.

Farm mechanization remains limited beyond land preparation. Although power tillers are commonly used in accessible production areas, transplanting, crop management, harvesting and grading continue to rely primarily on manual labour, increasing production costs during peak seasons.

Vegetable Production Trends, Constraints and Opportunities

FGDs and KIIs indicate that vegetables have become the preferred commercial enterprise for many farming households because of their relatively short production cycle, regular cash income and strong market demand (**Table 6.26**). Farmers have progressively diversified from traditional cereal production into high-value vegetables, particularly in Gewogs with good market access.

Despite this transition, producers face several production and marketing challenges. HWC, irregular irrigation during the dry season, rising labour costs and increasing pest and disease incidence remain major production constraints. Farmers also highlighted the limited availability of quality seed, inadequate technical support for integrated pest management, and high dependence on external production inputs.

Marketing constraints are equally significant. Seasonal gluts frequently depress farmgate prices, while inadequate grading, packaging, storage and transportation reduce product quality and market competitiveness. The absence of organized aggregation and processing facilities further limits opportunities for value addition and market expansion.

Table 6.26: Qualitative findings on vegetable systems (FGDs & KIIs)

Structural Theme	Core Findings
Enterprise Profile	Vital cash and household nutrition enterprise. Chili, potato, brassicas, and legumes dominate. Driven predominantly by female farmers.
Key Constraints	Heavy HWC damage, severe winter/spring irrigation deficits, viral/fungal blights, labour shortages, and costly inputs.

Market Challenges	Fragmented production, weak farmer groups, high transport costs, unstable prices, and limited buyers reduce profitability.
Post-Harvest Gaps	Limited storage, packaging, processing, and market infrastructure restrict value addition and expansion.
Priority Interventions	Protected cultivation (polyhouses), drip/sprinkler irrigation, solar drying technology, group aggregation centres, and school/institutional off-take contracts.

(Source: Focus Group Discussions and Key Informant Interviews ,2026)

Integrated Synthesis: Vegetable Production System

Vegetable production represents the most productive and commercially dynamic farming enterprise within the GEF-8 project area. Compared with staple crops, vegetables generate substantially higher returns per unit area and provide households with regular cash income throughout the year. The widespread shift towards vegetable cultivation observed during FGDs reflects increasing farmer confidence in the sector and its important role in agricultural commercialization.

However, the survey also demonstrates that higher productivity does not necessarily translate into higher profitability. Farm income remains highly sensitive to production costs, labour availability, market price fluctuations and post-harvest losses. HWC, inadequate irrigation, pest outbreaks and weak post-harvest systems continue to reduce production efficiency and increase marketing risks.

Future interventions should therefore emphasize value-chain development alongside production improvement. Priority investments include expanding climate-resilient irrigation systems, strengthening integrated pest and nutrient management, improving access to quality seed and planting materials, establishing producer groups for collective marketing, and upgrading post-harvest infrastructure for grading, storage and processing. These measures would improve product quality, reduce losses and strengthen farmers' ability to access higher-value domestic and institutional markets.

6.5.6 Integrated Farming System Demonstration Model – Draewong Village, Khaling Gewog

Background and Existing Farming System

Integrated Farming Systems (IFS) integrate crop, livestock and agroforestry enterprises to improve resource-use efficiency, diversify household income and enhance resilience to climate and market risks. Under the GEF-8 project, Draewong village (Gomchu-Kholdung Chiwog, Khaling Gewog) has been identified as a demonstration site for a mechanized commercial IFS model centred on buckwheat production, complemented by maize, potato, vegetables and livestock enterprises.

Baseline household survey findings from Khaling Gewog (**Table 6.27**) indicate a relatively diverse farming system with favourable conditions for IFS development. Households reported an average landholding of 2.29 acres, cultivation of approximately three crops per household, and relatively high adoption of production inputs, including chemical fertilizers (92%), farmyard manure (88%; average 747 kg/household) and farm machinery services (88%). Agroforestry practices were reported by 46% of households, while livestock contributed to household income for 25% of surveyed households. These characteristics provide a foundation for strengthening integrated crop–livestock production systems.

Qualitative assessments conducted specifically in Draewong village further highlight several site-level advantages for establishing a commercial IFS model. These include reliable irrigation, relatively gentle terrain suitable for mechanization, and contiguous agricultural land that can support coordinated production planning and efficient resource management.

However, despite these favourable conditions, agricultural production in Draewong remains below its potential due to demographic and labour-related constraints. Rural outmigration and an ageing farming population have contributed to increasing land abandonment, with approximately 40% of cultivable land currently left fallow. Of the 25 registered households in the village, only 12 are permanent residents. Commercial potato production has declined due to rising machinery rental costs, increasing input prices and labour shortages, while livestock integration remains limited by inadequate fodder availability, reported by

92% of surveyed households in Khaling Gewog (**Table 6.27**), further constrains agricultural expansion and productivity.

Table 6.27: Key household characteristics for integrated farming in Khaling Gewog (n=24)

System Parameter	Baseline Status
Land Resources	Mean landholding of 2.29 acres/HH; ~40% of arable land currently fallow.
Farming Diversity	Average of 3 crops grown/HH; 46% practice agroforestry systems.
Production Infrastructure	Reliable irrigation; high adoption of fertilizers, FYM, and farm machinery.
Livestock Role	Contributes income to 25% of HHs; livestock management led primarily by women.
Climate Adaptation	Climate-smart practices adopted by 42% of HHs; residue burning remains a challenge.
Primary Risk	Human–wildlife conflict reported by 92% of surveyed households.

(Source: Baseline HH Survey, 2026)

Lessons from Previous Farming Initiatives

Draewong has previously demonstrated the potential for commercial farming. In 2022, a youth-led enterprise cultivated approximately 9.8 acres of rehabilitated fallow land using mechanized land preparation and protected cultivation, focusing primarily on bitter buckwheat. Although crop performance was satisfactory, the initiative was discontinued because of weak market linkages, inadequate technical support, post-harvest losses and poor financial returns.

This experience highlights that successful commercialization requires more than improved production. Long-term viability depends equally on reliable mechanization services, coordinated technical support, effective producer organization and secure market access. Under current demographic conditions, small mechanized producer groups are likely to be more sustainable than labour-intensive collective farming approaches.

Integrated Synthesis: Integrated Farming

The baseline assessment demonstrates that Draewong offers favourable biophysical conditions for developing a commercial Integrated Farming System but faces significant socio-economic constraints. Reliable irrigation, high levels of mechanization and diversified crop production provide a strong foundation for intensification. However, continued rural outmigration, extensive fallow land, labour shortages, HWC, and weak market systems currently limit agricultural productivity and profitability.

The proposed IFS model provides an opportunity to address these constraints through a more integrated production approach that strengthens linkages between crops, livestock and natural resource management. Rehabilitating fallow land, recycling nutrients through crop–livestock integration and diversifying farm enterprises would improve resource-use efficiency while reducing production risks. At the same time, strengthening producer organization and market coordination would improve the economic viability of commercial farming.

Project interventions should therefore focus on four complementary areas: (i) restoring fallow land through coordinated mechanization services; (ii) strengthening crop–livestock integration by expanding fodder production and improving manure recycling; (iii) enhancing climate resilience through agroforestry, improved soil management and effective HWC mitigation; and (iv) establishing a commercially viable producer cooperative supported by post-harvest facilities, value addition and institutional market linkages. Together, these interventions would transform Draewong into a scalable demonstration model for integrated farming in eastern Bhutan.

6.5.7 Dairy Production System

Overview of Dairy Production

Dairy farming is an integral component of mixed farming systems in eastern Bhutan, providing regular household income, nutritious food and organic manure for crop production. The sector is characterized by two distinct production systems: (i) market-oriented mid-altitude dairy based on improved cattle, particularly

Jersey crosses, supplying fresh milk to urban markets; and (ii) traditional highland pastoral systems based on yak, zo/zom and local cattle, producing butter, cheese (*datshi*) and other indigenous dairy products. Under the GEF-8 project, dairy development is prioritized across 11 Gewogs: Minjey (Lhuentse), Jurmed and Silambi (Mongar), Decheling (Pemagatshel), Bumdeling, Khamdang and Ramjar (Trashiyangtse), Martshala (Samdrup Jongkhar), and Merak, Sakteng and Yangneer (Trashigang).

The census data (IALC, 2025) highlight the importance of dairy within the regional livestock economy. Across the six project Dzongkhags, the livestock population comprises 35,562 improved cattle (41%), 38,475 local cattle (44%) and 13,685 yak and zo/zom (16%) (NSB, 2026). Jersey crossbreds dominate commercial dairy production, while yak-based systems remain concentrated in the high-altitude landscapes of Merak and Sakteng Gewogs. This diversity reflects the broad agro-ecological gradient across eastern Bhutan and underscores the need for location-specific development strategies.

Dairy Production Performance in Priority Gewogs

The Baseline Household Survey (2026) indicates that dairy farming is widely practiced, with 141 of the 192 surveyed households (73%) engaged in milk production (**Table 6.28**). Participation was highest in Merak (93%), Bumdeling (88%), Martshala (88%), Yangneer (87%), Jurmed (85%) and Khamdang (85%), demonstrating the importance of dairy as a livelihood enterprise across both highland and mid-altitude production systems.

Livestock composition reflects local agro-ecological conditions. Improved cattle predominate in Bumdeling, Khamdang, Yangneer and Minjey, where dairy production is primarily market-oriented. In contrast, local cattle, yak and zo/zom dominate the pastoral systems of Merak and Sakteng, where dairy production is closely integrated with seasonal grazing systems and traditional processing practices.

Although household participation is high, production systems differ substantially in their level of commercialization. Mid-altitude producers primarily market fresh milk, whereas highland households derive greater value from processing milk into butter and traditional cheese, enabling longer storage and transport from remote production areas.

Table 6.28: Dairy farming characteristics in priority Gewogs

Gewog	*N* Surveyed	*N* Practising Dairy (%)	Improved Cattle (No.)	Local Cattle (No.)	Yak + Zo/Zom (No.)	Major Feed Sources
Minjey	11	9 (82%)	40	23	–	Pasture, feed, crop residue
Silambi	13	10 (77%)	4	45	–	Fodder, feed
Jurmed	13	11 (85%)	27	4	–	Fodder, pasture, residue
Decheling	25	10 (40%)	31	6	–	Residue, fodder, pasture
Bumdeling	16	14 (88%)	117	–	–	Residue, feed, pasture
Khamdang	27	23 (85%)	90	–	–	Pasture, fodder, feed
Ramjar	13	2 (15%)	5	–	–	Pasture, residue
Merak	14	13 (93%)	7	326	237	Pasture, residue
Sakteng	13	8 (62%)	50	195	215	Pasture, fodder
Yangneer	23	20 (87%)	55	24	–	Fodder, residue, feed
Martshala	24	21 (88%)	15	87	–	Residue, fodder
Total	**192**	**141 (73%)**	**441**	**710**	**452**	

(Source: Baseline HH Survey, 2026)

Production Constraints, Product Utilization and Market Dynamics

The qualitative analysis (FGDs and KIIs) indicates that production constraints differ between the two dairy systems, although both face limitations that reduce productivity, product quality and market competitiveness (**Table 6.29**).

In the mid-altitude cattle systems, winter fodder shortages, rising feed costs, limited access to quality breeding services and disease outbreaks, particularly Lumpy Skin Disease and mastitis, reduce milk yield and quality. These challenges are compounded by inadequate milk collection and chilling infrastructure, resulting in rapid spoilage during transport to processing centres.

Highland dairy systems face a different set of constraints. Declining rangeland productivity, seasonal water shortages and rural outmigration are reducing labour availability for traditional livestock management. Although butter and *datshi*(cheese) remain highly valued products, traditional processing equipment, inconsistent hygiene standards and limited packaging technologies reduce product quality, shorten shelf life and constrain access to premium markets.

Across both systems, inadequate producer organization, weak cold-chain infrastructure and limited value addition remain major barriers to commercial expansion.

Table 6.29: Qualitative findings on dairy production (FGDs &KIIS)

Structural Theme	Core Operational Findings
Production Systems	Dual system: Commercial Jersey/HF in mid-altitudes; traditional yak/zo in highlands.
Commercial Potential	High local demand for fluid milk, butter, soft cheese (datshi), and hard cheese (chhurpi).
Key Constraints	High feed costs, disease outbreaks (Lumpy Skin Disease, Mastitis), and labour shortages.
Processing & Quality	Butter and datshi dominate; minimal formal quality testing or standardization.
Infrastructure & Cold Chain	Milk collection exists in select Gewogs; major cold-chain gaps persist in remote areas.
Priority Interventions	Modernize feed/silage, establish MCCs, upgrade processing sanitation, adopt vacuum sealing.

(Source: Focus Group Discussions and Key Informant Interviews ,2026)

Integrated Synthesis: Dairy Production System

The baseline assessment demonstrates that dairy production offers considerable opportunities for improving rural incomes, but the two production systems require different development strategies. Mid-altitude cattle systems have strong potential to increase commercial milk production, provided that feed resources, breeding services, animal health and milk collection infrastructure are strengthened. In contrast, highland pastoral systems are better positioned to increase value through improved processing, product quality and branding of traditional dairy products rather than expanding milk volume.

Survey findings further indicate that the principal constraints are not limited to production alone. Weak market organization, inadequate cold-chain infrastructure and limited post-harvest technologies reduce the value captured by producers across both systems. Consequently, improving productivity must be accompanied by investments in milk handling, processing and market development.

Project interventions should therefore adopt a differentiated approach. In the mid-altitude dairy systems, priority should be given to strengthening fodder production, improving breeding and veterinary services, expanding village milk collection and chilling facilities, and promoting hygienic milk handling. In the highland pastoral systems, interventions should focus on improving processing technologies, food safety, packaging and branding of traditional dairy products while supporting sustainable rangeland management.

Strengthening producer organizations and market linkages across both systems will be essential to improve product quality, reduce post-harvest losses and enhance farm profitability.

6.5.8 Poultry Production System

Overview of Poultry Production

Poultry farming is an emerging component of commercial livestock production in eastern Bhutan, providing rapid income generation, low land requirements and regular cash flow, particularly through egg sales. Unlike dairy, which is widely integrated into mixed farming systems, poultry production is concentrated among specialized producers operating small- to medium-scale commercial units. The sector is primarily layer-based, while broiler production remains limited due to weak processing and market infrastructure.

Under the GEF-8 project, poultry production is focussed in seven Gewogs: Drepong, Decheling, Khamdang, Ramjar, Lumang, Kangpar and Langchenphu. IALC (2025) data indicate that poultry production is relatively concentrated across the eastern region, with 106,269 birds managed by 2,729 poultry keepers across the priority Dzongkhags (NSB, 2025). Improved layer breeds dominate the regional flock, accounting for 95,493 birds (90%), followed by local breeds (8%; 8,595 birds) and broilers (2,181 birds). Production is concentrated in Mongar (34,223 birds), Pemagatshel (25,228 birds) and Samdrup Jongkhar (23,126 birds), while broiler production is largely confined to Samdrup Jongkhar.

The poultry sector reflects two emerging production pathways: (i) commercial layer production focused on supplying fresh eggs to local markets; and (ii) small-scale broiler production with potential for expansion where reliable markets, processing facilities and cold-chain systems are available. These differences highlight the need for targeted rather than generalized poultry development approaches.

Poultry Production Performance in Priority Gewogs

The Baseline Household Survey (2026) indicates that poultry production remains limited but commercially oriented among participating households. Only 10 of the 124 surveyed households (8%) operated layer units, with participation highest in Drepong (20%), Kangpar (15%) and Decheling (12%) (**Table 6.30**). Broiler production was recorded only in Langchenphu, where four households maintained 53 birds.

Despite low household participation, existing layer farms demonstrate significant commercialization. The 10-layer producers collectively managed 1,107 birds and produced approximately 105,700 eggs annually, of which 86,900 eggs (82.2%) were marketed. Farmgate prices ranged from Nu. 12–18 per egg. Decheling accounted for the largest share of production, with one commercial operator managing 990 birds and producing approximately 94,000 eggs annually.

The production structure differs from other livestock enterprises, as poultry ownership is concentrated among specialized producers rather than being widely distributed across households. This indicates that future interventions should focus on strengthening existing enterprises, improving efficiency and developing organized producer networks rather than promoting widespread small-scale adoption.

Table 6.30: Poultry production characteristics in priority Gewogs

Gewog	*N* Surveyed	*N* with Poultry (%)	Poultry Population	Egg Production / Year	Eggs Sold /Year	Egg Price (Nu/egg)	Main Challenges
Drepong	10	2 (20%)	60	6,000	4,000	15	No buyers, low price
Decheling	25	3 (12%)	990	94,000	78,000	16	No buyers, low price
Khamdang	27	1 (4%)	10	1,000	900	12	Low price, no buyers
Ramjar	13	0	0	–	–	–	–
Lumang	29	1 (3%)	8	800	800	18	No buyers, low price
Kangpar	20	3 (15%)	39	3,900	3,200	15	Low price, no buyers

Total (Layer)	**124**	**10 (8%)**	**1,107**	**105,700**	**86,900**	–	–
Langchenphu (Broiler)	11	4 (36%)	53	–	–	–	No buyers, low volume

(Source: Baseline HH Survey, 2026)

Poultry Production Constraints, Product Utilization and Market Dynamics

FGDs and KIIs indicate that poultry development is constrained by production inputs, farm management capacity and weak value-chain infrastructure rather than by lack of market demand (**Table 6.31**). Existing layer enterprises have relatively strong local market acceptance, with eggs primarily sold directly to consumers and local traders. However, inconsistent production, limited quality control and weak aggregation systems reduce opportunities for expanding commercial supply.

Layer production is constrained by high feed costs, irregular access to quality chicks, disease risks and limited technical support. Farmers also reported challenges related to egg quality, including small egg size, shell weakness and breakage during storage and transportation. Limited availability of appropriate egg trays and poor handling practices contribute to post-harvest losses.

Broiler development faces additional constraints. The absence of hygienic slaughter facilities, cold storage and organized marketing channels limits expansion beyond small-scale production. Without reliable market arrangements, producers face higher risks associated with unsold birds and price fluctuations.

Table 6.31: Qualitative findings on poultry production (FGDs & KIIs)

Structural Theme	Core Findings
Production Profile	Poultry is an emerging livelihood enterprise, mainly based on small-scale layer farming, with strong local demand for eggs and limited commercial broiler operations.
Commercial Potential	Egg markets are favourable, with demand exceeding supply. Broiler expansion requires reliable markets and stronger value chain support.
Key Constraints	High feed costs, labour shortages, irregular chick supply, limited training, disease risks, and weak veterinary access constrain growth.
Management & Infrastructure	Improved housing and biosecurity are increasing, but gaps remain in farm management, feed systems, and production infrastructure.
Market & Value Chain	Layer marketing is well established locally, while broiler enterprises face challenges in market access, transport, cold chain, and institutional buyers.
Priority Needs	Improve feed and chick supply, technical support, veterinary services, institutional markets, and youth-focused poultry enterprises.

(Source: Focus Group Discussions and Key Informant Interviews, 2026)

Integrated Synthesis: Poultry Production System

The baseline assessment demonstrates that poultry has potential to develop into a commercially viable livestock enterprise due to strong local demand, rapid production cycles and the presence of emerging commercial producers. However, unlike dairy systems, poultry production is currently concentrated among a small number of specialized operators, requiring a cluster-based development approach rather than broad household-level promotion.

Layer production offers the greatest immediate opportunity for expansion. Strengthening existing enterprises through improved access to quality chicks, reliable feed supply, veterinary services, biosecurity measures and technical training would enhance productivity and consistency. Improved egg handling, grading, packaging and producer aggregation would further increase market competitiveness and reduce post-harvest losses.

Broiler production requires a more selective approach. Expansion should be promoted only in areas with demonstrated market demand and adequate supporting infrastructure. In locations such as Langchenphu,

opportunities exist for developing small-scale broiler clusters supported by hygienic slaughtering facilities, cold storage and organized market arrangements.

Project interventions should therefore focus on: (i) strengthening commercial layer production through improved inputs, flock management and market organization; (ii) developing targeted broiler value chains where market conditions are favourable; and (iii) strengthening producer groups and service linkages to improve sustainability. Overall, poultry development under GEF-8 should emphasize commercial intensification, improved production efficiency and stronger market integration rather than increasing the number of small-scale producers.

6.6 Biodiversity and Ecosystem Services (Cl 4.1)

6.6.1 Ecosystem Services and Natural Resource Dependence

Rural livelihoods across the six project Dzongkhags are profoundly dependent on the ecosystem services provided by Eastern Bhutan's extensive forest and natural habitat areas. The survey documented dependency on six principal categories of forest-derived ecosystem services among the 412 HH (**Table 6.32**). Timber provisioning was the most widely reported dependency, cited by 84% (344 HH), reflecting continued reliance on forest timber for construction in a rural landscape where alternative building materials are scarce. Water supply—including drinking water and irrigation from forest-regulated watersheds—was reported by 75% (308 HH), confirming the critical hydrological service role of Eastern Bhutan's forests for agricultural production and HH welfare. Fuelwood dependency was reported by 58% (239 HH), indicating that the majority continue to rely on biomass energy for cooking and heating. Fodder provisioning from forests and natural habitats was cited by 54% (223 HH). Non-timber forest products were identified as a dependency by 40% (165 HH), while herbs and medicinal plants specifically were cited by 16% (67 HH) - a dependency of significance for traditional medicine and for potential NTFP value chain development.

Table 6.32: HH ecosystem service dependency (n = 412)

Ecosystem Service Category	No. HH Reporting	% of Total Sample
Timber / construction material	344	83.5%
Water supply / drinking / irrigation	308	74.8%
Fuelwood / cooking energy	239	58.0%
Fodder / livestock grazing	223	54.1%
Non-timber forest products (NTFPs)	165	40.0%
Medicinal herbs / plant medicines	67	16.3%
Forest proximity (HH)	378	91.7%
Wildlife / pollinator observation (sometimes)	207	50.2%
Wildlife / pollinator observation (often)	91	22.1%

(Source: Baseline HH Survey, 2026)

6.6.2 Forest Proximity and Habitat Function

The spatial relationship between surveyed HH and natural forest areas is extremely close: 92% (378 HH) reported residing in proximity to forest areas (**Table 6.32**). Wildlife and pollinator observations on farmland were reported with notable frequency: 22% (91 HH) reported observing wildlife or pollinators "often," 50% (207 HH) "sometimes," and 57 each "rarely" or "never." In aggregate, 72% of HH observe wildlife or pollinators on their farmland at least sometimes and often, indicating that the farm-forest matrix in Eastern Bhutan continues to function as ecologically permeable habitat—a characteristic of high ecological significance for biodiversity conservation and for pollination services supporting crop production.

The four protected areas within and adjacent to the project area, SWS (739.82 km²), BWS (1,521.27 km²), PNP (905.44 km²), and JWS (350.39 km²) - together with nine biological corridors covering approximately

2,690 km², constitute a structurally coherent conservation landscape. The BWS's designation as an IBA for migratory black-necked cranes illustrates the internationally significant biodiversity values sustained in part by the landscape management practices of farming communities in adjacent Gewogs.

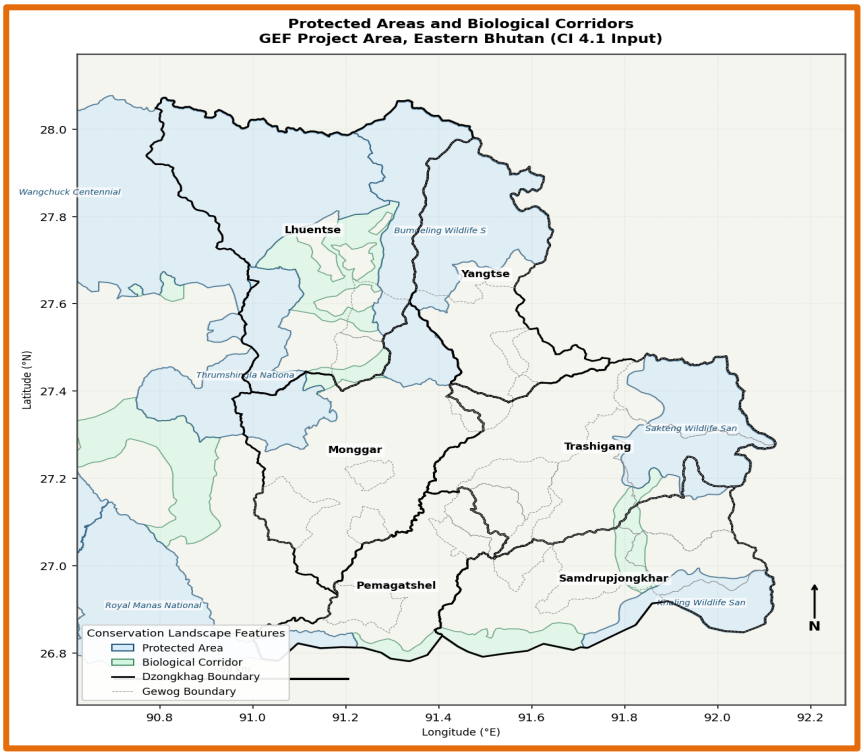


Figure 6.10: Protected areas and biological corridors in eastern Bhutan (GEF8 Project area)
(Source: DoFPS protected area boundaries; NLCS administrative data, 2020)
(Protected areas: Sakteng Wildlife Sanctuary (739.82 km²), Bumdeling Wildlife Sanctuary (1,521.27 km²), Phrumsengla National Park (905.44 km²), Jomotshangkha Wildlife Sanctuary (350.39 km²).

6.6.3 Agro-Biodiversity

The on-farm agro-biodiversity baseline reveals that Eastern Bhutan's farming communities are active custodians of significant crop genetic diversity. Traditional and local crop varieties were cultivated by 80% (329 HH), with an average of 3.2 crop varieties per household (**Table 6.33**). These varieties include staple cereals, pulses, vegetables, and root crops adapted to the diverse agroecological conditions across the project area, highlighting the continued importance of indigenous crop genetic resources for food security, climate resilience, and agricultural sustainability.

Table 6.33: Traditional crop varieties grown

Traditional/local crop varieties grown (n=412) (n)		**Traditional/local crop varieties grown (n=412) (%)**		**Mean crop varieties species (n=412) (n)**	
Yes	No	Yes	No	Total Sum	Mean
329 HH	83 HH	80	20	1320	3

(Source: Baseline HH survey, 2026)

Agroforestry systems—intentional integration of tree species within cropping or homestead systems—were practised by 39% (159 HH), with a mean of 6.0 tree species per agroforestry plot (**Table 6.34**). Fruit trees (33%) were the most common, followed by fodder trees (26%), other tree species (31%), and timber trees (10%). These diversified farming systems enhance on-farm biodiversity while contributing to soil conservation, carbon sequestration, and resilience to climate change.

Table 6.34: Agroforestry practices

Agroforestry practised (n=412) (%)		Mean tree species (n=159)		Type of tree species grown (%)			
Yes	No	Total Sum	Mean	Fruit tree	Fodder tree	Timber	Other
39	61	955	6	33	26	10	31

(Source: Baseline HH survey, 2026)

6.6.4 Natural Habitat (CI 4.1)

GEF Core Indicator 4.1 measures the area of natural habitat within the project area. Based on GIS analysis of the LULC 2020 dataset, the total natural habitat area is calculated as the sum of forest cover (891,476 ha), shrubs (44,698 ha), meadows (31,876 ha), and alpine scrubs (66,664 ha), yielding a CI 4.1 baseline area of 1,034,714 ha. This represents 91 % of the total project area of 1,136,102 hectares and constitutes the natural habitat foundation underpinning the biodiversity and ecosystem service values documented in this section. The project's SLM, agroforestry, and rangeland restoration interventions will be designed to maintain and enhance the ecological connectivity between this natural habitat base and the agricultural landscape matrix. The close interaction between communities and natural ecosystems, with 92% of households located near forests and 72% reporting wildlife presence on farmland, highlights the need to promote biodiversity-friendly farming practices that balance agricultural production with ecosystem conservation (**Table 6.32**). The widespread cultivation of traditional crop varieties, maintained by 80% of households with an average of 3.2 varieties per household, provides a strong foundation for conserving agrobiodiversity and strengthening climate resilience (**Table 6.33**). In addition, the relatively high adoption of agroforestry (39%), with an average of six tree species per plot, presents significant opportunities to scale up agroforestry as a sustainable land management approach that enhances biodiversity, ecosystem services, and farm productivity (**Table 6.34**).

6.7 Climate Change and Environmental Impacts

6.7.1 Climate Risk Perceptions – Experience and Types of Climate Impacts

Climate change is not an abstraction for farming and pastoral communities in Eastern Bhutan: 83% (343 HH) reported having directly experienced at least one climate change impact affecting their community or farm system. This high rate of climate impact experience is consistent with documented regional warming and rainfall variability trends across the Eastern Himalaya, confirming that climate risks are already materially affecting agricultural livelihoods. These findings underscore the need to prioritize climate-smart agriculture (CSA) as a core project intervention. The moderate Climate-Smart Agriculture Adoption Index (CSAI) of 0.59 indicates a solid foundation on which to build through expanded training, extension services, and the wider dissemination of proven CSA practices.

Erratic rainfall (36%) was perceived as the most prevalent climate hazard, followed by increasing pest and disease outbreaks (22%), temperature variability (22%), and recurrent droughts (17%), while flooding (3%) was reported comparatively less frequently (**Figure 6.11**). Adaptation measures should specifically address the most frequently reported climate risks, including erratic rainfall, pest and disease outbreaks, and temperature variability.

The nature and intensity of these risks vary considerably between locations. For instance, Lumang Gewog in Trashigang experiences a combination of severe erratic rainfall and drought, whereas Yangneer Gewog faces frequent erratic rainfall accompanied by heightened pest and disease infestations, illustrating the diverse manifestations of climate change within relatively small geographical areas.

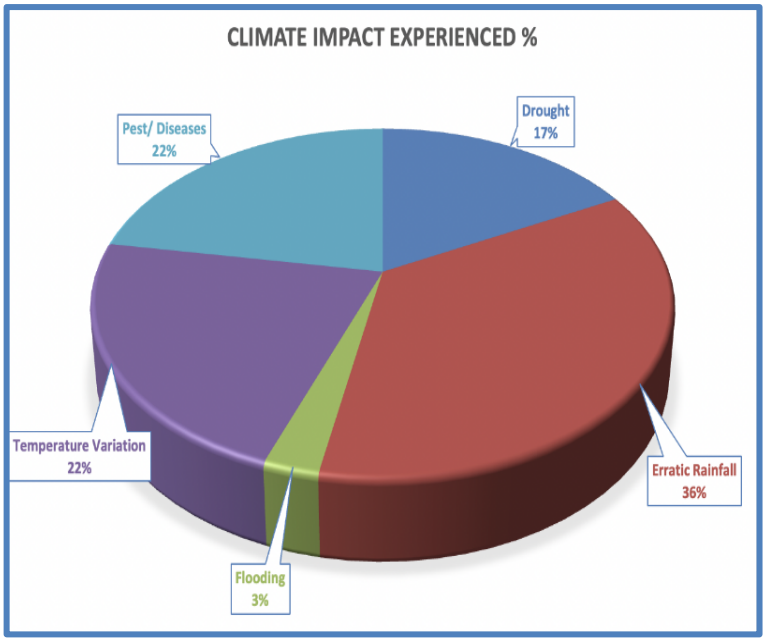


Figure 6.11: Reported experience of climate change
(Source: Baseline HH survey, 2026)

Among the surveyed Dzongkhags, Trashigang recorded the highest proportion of HH reporting experiences of climate change impacts, followed by Pemagatshel, skewed by reported flooding incidents. In contrast, Lhuentse recorded the lowest proportion, although respondents there also acknowledge increasing climate variability.

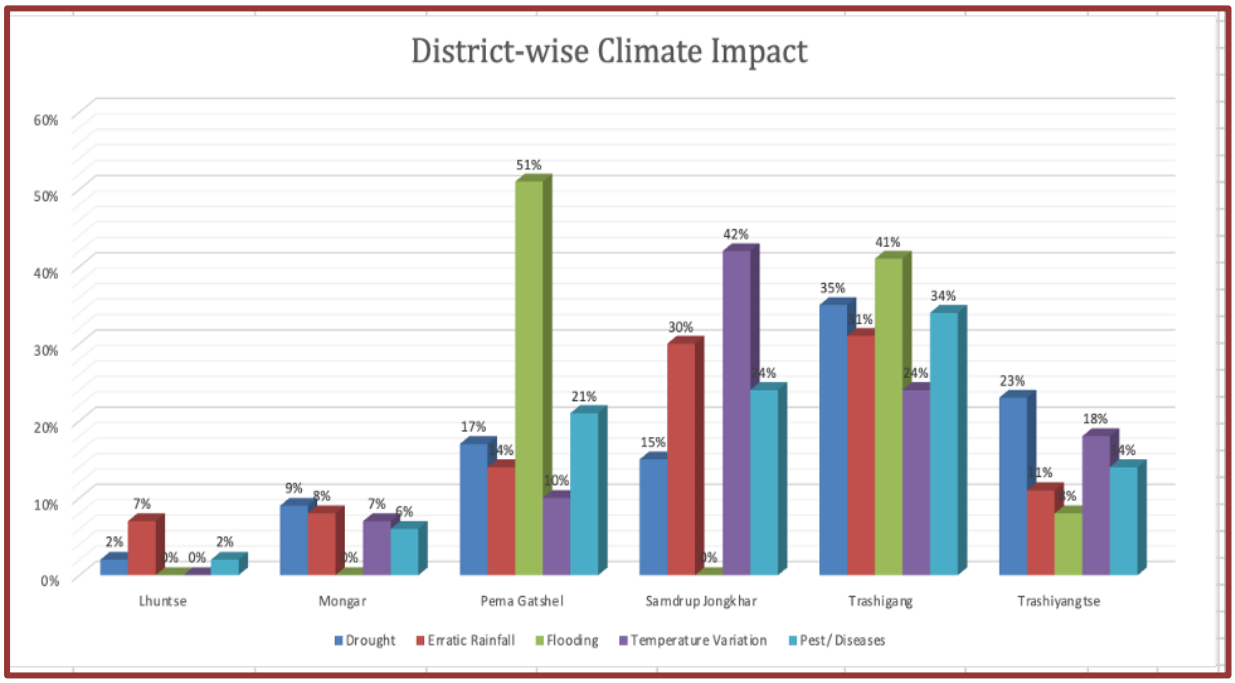


Figure 6.12: Spatial distribution of perceived climate change impacts
(Source: Baseline HH survey, 2026)

The spatial distribution of perceived climate impacts reveals considerable variation across Gewogs. Lumang, Merak and Sakteng in Trashigang, Lauri, Martshala and Serthi in Samdrup Jongkhar, Zobel in Pemagatshel, and Drepong in Mongar emerged as the most climate-affected Gewogs. Such geographical differences highlight

the localized nature of climate risks and underscore the need for location-specific adaptation strategies rather than uniform interventions across the project landscape.

The qualitative findings from the FGD and KIIs strongly reinforce the HH survey findings. Farmers consistently described climate change as an escalating threat to agricultural production and rural livelihoods, characterized by rising temperatures, increasingly erratic rainfall, prolonged dry spells, declining water availability, and more frequent outbreaks of crop and livestock pests and diseases. Communities further observed noticeable shifts in agroecological suitability, with crops such as citrus and oranges no longer performing well in their traditional production areas, while heat-sensitive crops, including chilli, have experienced declining productivity. Similarly, arecanut now thrives in some localities which was not possible before. In high-altitude communities, respondents additionally reported irregular snowfall, reduced water availability for livestock, and the emergence of new livestock diseases, collectively indicating that climate variability is becoming increasingly widespread, complex, and severe across diverse agroecological zones.

Adverse Impact on Agriculture and Livestock

Overall, 62% (256 HH) reported adverse impacts on agriculture and livestock, closely reflecting patterns of climate-risk perception and indicating a strong link between experienced climatic changes and agricultural performance. Farmers widely acknowledge that climate variability is increasingly affecting the productivity, profitability, and sustainability of crop and livestock production systems.

Erratic rainfall, prolonged dry spells, heat and water stress, and increasing pest and disease pressures are contributing to lower crop yields, irregular harvests, poor germination, and production losses. Livestock systems are similarly affected by fodder shortages, declining pasture quality, emerging diseases, reduced milk productivity, and changing snowfall patterns, particularly in high-altitude areas. Compounded by inadequate irrigation, limited extension and veterinary services, and restricted access to climate-resilient technologies, these pressures are increasing production risks, reducing HH incomes, and weakening the long-term resilience of farming systems.

6.7.2 Adaptation Practices

The findings indicate that farming HH have adopted a diverse range of adaptation measures to cope with the increasing impacts of climate change (**Figure 6.13**). Among the various strategies, crop diversification and the adoption of climate-smart agricultural practices emerged as the most widely implemented responses across the six project Dzongkhags, reflecting farmers' efforts to reduce production risks and enhance livelihood resilience. In contrast, accessing credit and financial services to finance climate adaptation was the least adopted strategy in most Dzongkhags, except in Khamdang Gewog of Trashiyangtse and among a small proportion of HH in a few other Dzongkhags. This suggests that while farmers are proactively implementing low-cost, farm-based adaptation measures, financial constraints continue to limit investments in more capital-intensive resilience-building interventions.

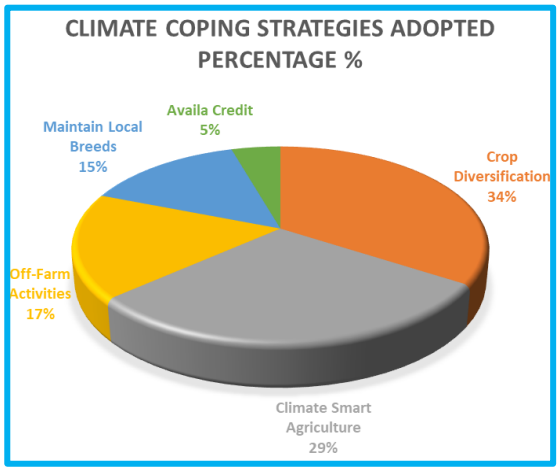


Figure 6.13: Climate coping strategies in agriculture
(Source: Baseline HH Survey, 2026)

The qualitative assessment corroborates and enriches the survey findings by providing deeper insights into the adaptation strategies employed by farming communities. Farmers reported adjusting planting and harvesting calendars to accommodate shifting rainfall patterns, cultivating drought-tolerant and climate-resilient crops such as quinoa, expanding smart irrigation through water harvesting and rotational water management, stall-feeding livestock using cultivated fodder and silage, strengthening pasture management, and increasing the application of organic manure to improve soil fertility. Additional measures include protecting crops through fencing against human-wildlife conflict, adopting integrated pest management practices, diversifying into livestock and high-value crops, and strengthening collective production and marketing through FG and cooperatives. Despite these encouraging initiatives, the widespread adoption and scaling of climate-resilient practices remain constrained.

Smart Irrigation

As part of the climate adaptation assessment, sprinkler irrigation emerged as the most widely adopted irrigation system across the 23 project Gewogs, followed by piped water supply and water harvesting systems, with comparatively lower adoption of drip irrigation and traditional canal-based systems (**Figure 6.14**). Notably, 14% of respondents reported having no reliable irrigation water supply, underscoring persistent gaps in water availability.

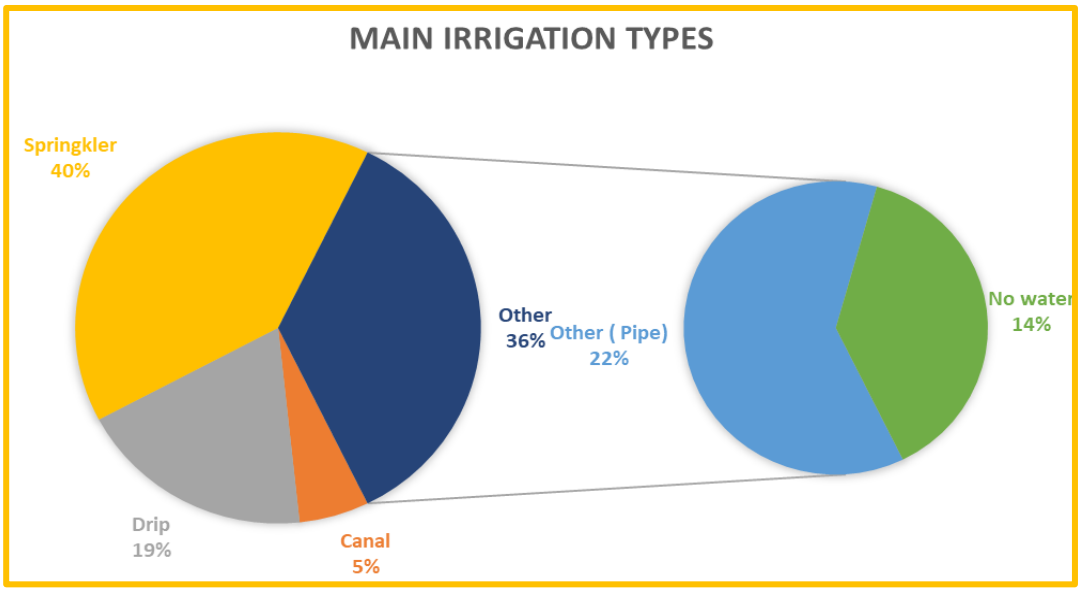


Figure 6.14: Main irrigation types used by farmers in the project landscape
(Source: Baseline HH Survey, 2026)

The increasing adoption of climate-smart irrigation technologies reflects positive progress towards strengthening climate resilience. As presented in **Figure 6.15**, Trashigang recorded the highest use of sprinkler irrigation (33%), while drip irrigation was most prevalent in Samdrup Jongkhar. In contrast, respondents from Pemagatshel and Mongar reported the greatest incidence of inadequate irrigation water supply, with the most affected Gewogs including Nanong (Pemagatshel), Silambi and Jurmed (Mongar), Sakteng (Trashigang), and Ramjar (Trashiyangtse).

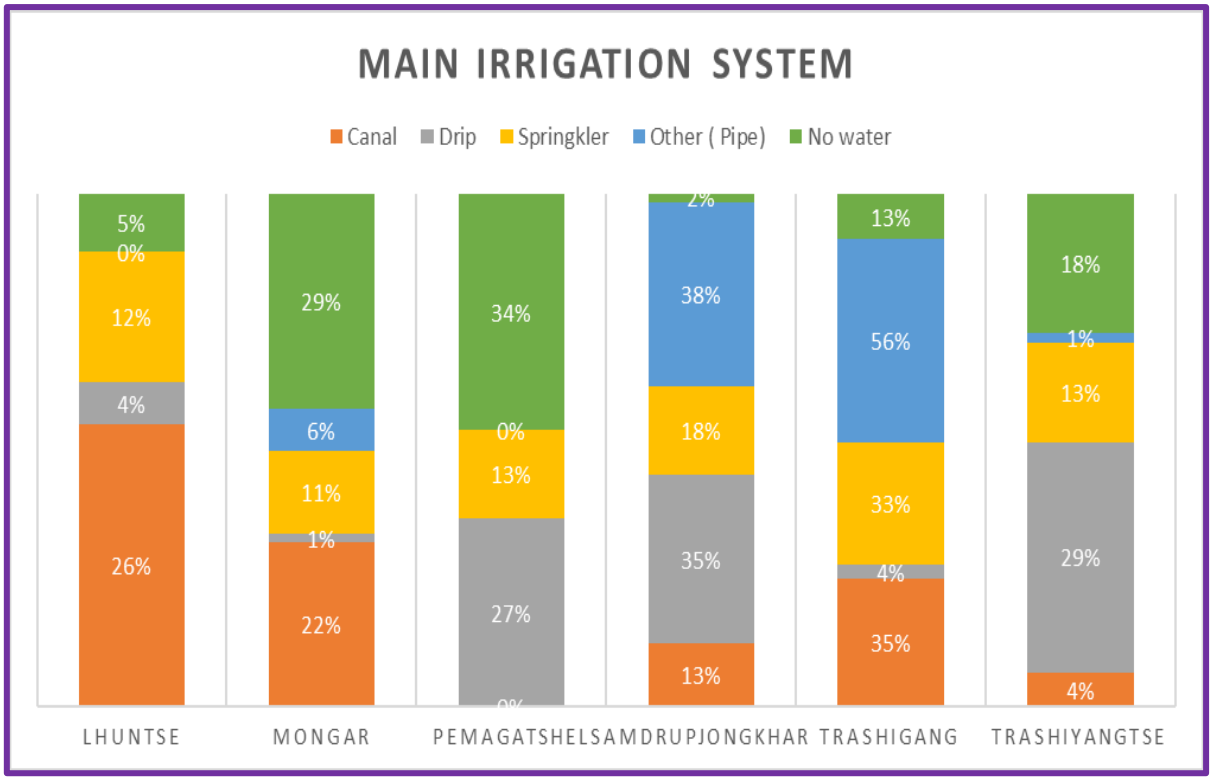


Figure 6.15: Irrigation types used under different project Dzongkhags
(Source: Baseline HH Survey, 2026)

Qualitative findings further reinforce these results, highlighting that inadequate and unreliable irrigation infrastructure, compounded by seasonal water scarcity, limited water storage, and inefficient distribution systems, continues to constrain agricultural productivity, restrict crop diversification, and limit year-round cultivation despite ongoing adaptation efforts.

Energy Sources

HH energy use has undergone a significant transition towards cleaner energy sources across the project landscape (**Figure 6.16**). Electricity is now the predominant source of HH energy, with 81% of respondents reporting its use, followed by liquefied petroleum gas (LPG) at 11%. In contrast, only 7% of HH continue to use fuelwood, while the adoption of biogas remains negligible at less than 1%, despite promotion through other development initiatives in eastern Bhutan. The high level of household access to electricity, coupled with relatively low dependence on fuelwood, provides a favourable foundation for reducing pressure on forest resources while supporting sustainable rural development.

Reliance on fuelwood persists in several remote Gewogs, particularly Gomdar and Serthi in Samdrup Jongkhar; Merak, Sakteng, and Lumang in Trashigang; Silambi and Jurmed in Mongar; and Zobel in Pemagatshel.

The qualitative assessment further indicates that improved access to electricity has substantially reduced HH's dependence on fuelwood, which is now used primarily for preparing livestock feed rather than daily cooking. Communities also expressed renewed interest in adopting improved biogas technologies to utilize livestock waste more efficiently and further reduce reliance on traditional biomass fuels.

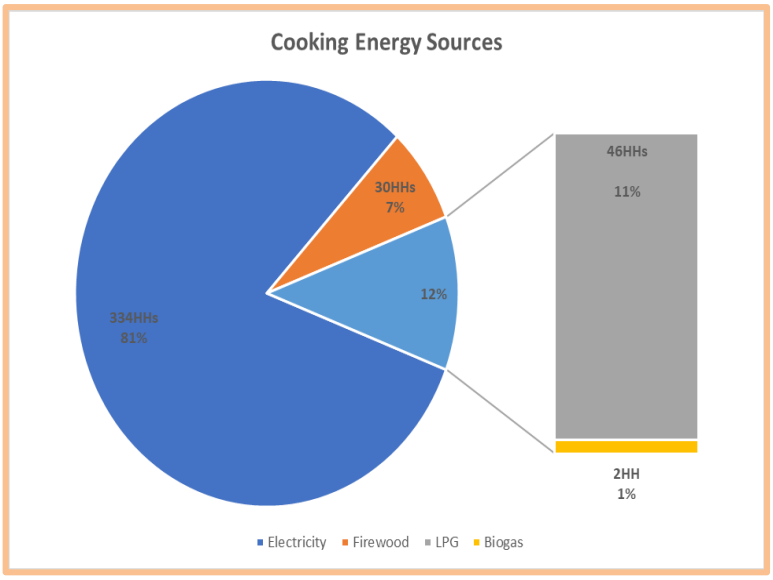


Figure 6.16: Different cooking energy sources
(Source: Baseline HH Survey, 2026)

Mitigation Strategies to reduce environmental impacts

The survey findings indicate that farmers have adopted a range of mitigation measures aimed at reducing the carbon footprint of agricultural production while enhancing the sustainability of farming systems. Among the practices reported, improved manure management emerged as the most widely adopted measure (48%), followed by reducing the use of chemical fertilizers (40%) and reusing crop residues for soil improvement and livestock feed (**Figure 6.17**). In contrast, minimum soil tillage was the least practiced mitigation measure, reflecting the continued reliance on conventional cultivation methods. These findings suggest that farmers are increasingly embracing low-cost, resource-efficient practices that enhance soil fertility, smart irrigation, recycle on-farm resources, and reduce reliance on external agricultural inputs.

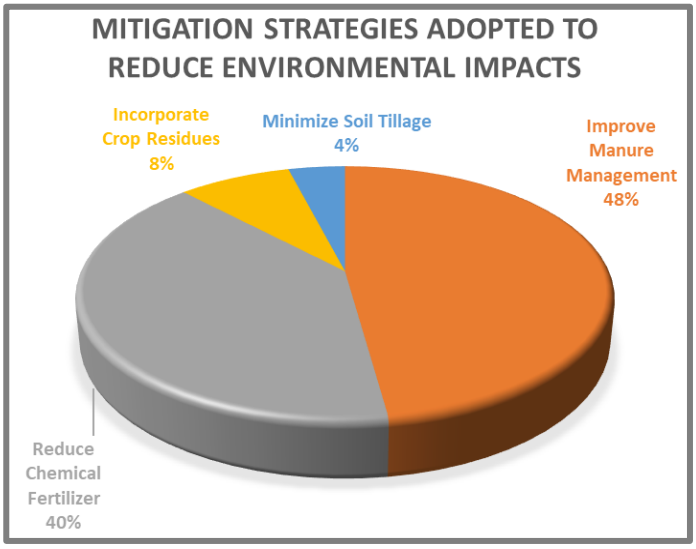


Figure 6.17: Mitigation strategies adopted to reduce environmental impacts
(Source: Baseline HH Survey, 2026)

The qualitative assessment substantiates these findings and provides deeper insights into the breadth of mitigation practices implemented. Farmers have progressively adopted sustainable land and livestock

management approaches that simultaneously reduce greenhouse gas emissions and improve environmental sustainability. These include the widespread application of farmyard manure and compost to enhance soil organic matter and reduce dependence on synthetic fertilizers, stall-feeding of livestock supported by cultivated fodder and improved pasture management to alleviate pressure on natural grazing lands, and the establishment of fodder trees and grasses that contribute to carbon sequestration while improving livestock nutrition.

Communities also reported a substantial reduction in fuelwood consumption following improved access to electricity, while several HH have previously adopted biogas systems and expressed strong interest in more efficient biogas technologies for productive utilization of livestock waste. Complementary practices such as water harvesting, crop diversification, reduced open grazing, sustainable pasture management, and protective fencing to minimize human-wildlife conflict further strengthen ecosystem integrity and agricultural productivity. Collectively, these measures contribute to improved soil and water conservation, lower greenhouse gas emissions, enhanced ecosystem resilience, and the long-term sustainability of agriculture and livestock production systems.

Manure Management and Use of fertilizers

Livestock manure management practices remain predominantly traditional, with 53% of HH reporting open manure storage, while 46% actively convert manure into compost for agricultural use (**Figure 6.18**). The adoption of biogas-based manure management is extremely limited, accounting for less than 1% of HH.

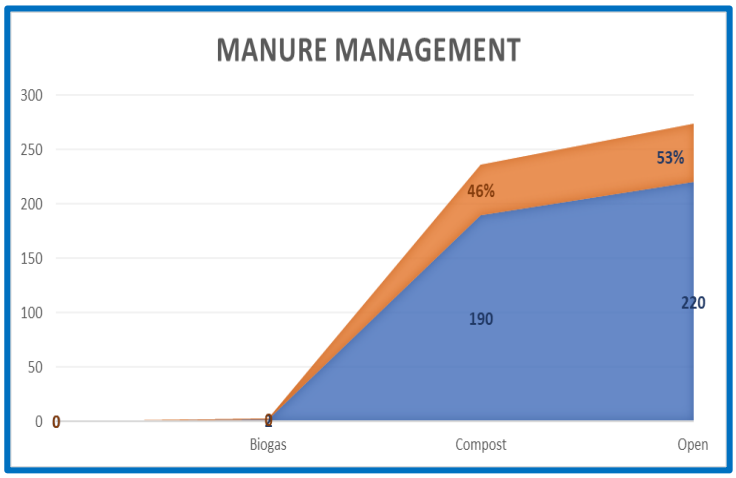


Figure 6.18: Types of manure management
(Source: Baseline HH Survey, 2026)

Composting practices are comparatively more prevalent in Samdrup Jongkhar, Pemagatshel, and Trashigang, whereas open manure management remains more common in Mongar, Trashiyangtse, and parts of Trashigang (**Table 6.35**).

Table 6.35: Manure management under different project Dzongkhags

Manure Management Options	Lhuentse(n)	Mongar(n)	Pemagatshel(n)	Samdrup Jongkhar(n)	Trashigang(n)	Trashiyangtse(n)
Biogas	-	-	-	2	-	-
Compost	26	3	40	59	39	23
Open	6	42	21	34	84	33
Total	**32**	**45**	**61**	**95**	**123**	**56**

(Source: Baseline HH Survey, 2026)

The qualitative findings demonstrate that livestock manure is widely collected and recycled as farmyard manure or compost, providing an important source of organic nutrients that improves soil fertility, enhances soil organic matter, and reduces dependence on synthetic fertilizers. Farmers recognized manure management not only as an essential component of sustainable crop production but also as a practical climate mitigation measure that promotes nutrient recycling, conserves soil resources, lowers greenhouse gas emissions, and contributes to more resilient and environmentally sustainable agricultural systems. The widespread use of open manure storage and crop residue burning further indicates the need to promote composting, improved manure handling, and residue incorporation to reduce emissions and improve soil health.

Organic manure remains the dominant source of soil fertility management, with 62% of HH relying primarily on farmyard manure and compost, reflecting the continued prevalence of low-input and environmentally sustainable farming systems (**Figure 6.19**). The use of chemical fertilizers is comparatively limited. Among the inorganic fertilizers, urea was the most widely applied, with 136 HH reporting a cumulative application of 8,739 kg, ranging from 1 to 1,500 kg per HH and averaging 64 kg, representing 23% of total fertilizer use. This was followed by Suphala, with 86 HH applying a combined 2,492 kg, accounting for 14% of fertilizer use and averaging 56 kg per HH. Single Super Phosphate (SSP) was the least utilized chemical fertilizer across the project area.

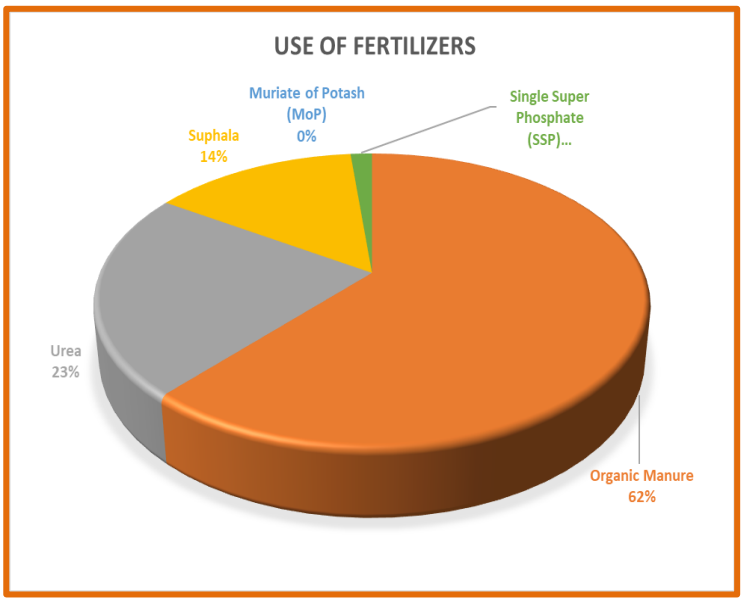


Figure 6.19: Types of fertilizers used by farmers
(Source: Baseline HH Survey, 2026)

The application of chemical fertilizers was concentrated in a limited number of Gewogs, notably Tsaenkhar and Minjey in Lhuentse; Yangneer, Kangpar, Khaling, and Lumang in Trashigang; Khamdang, Ramjar, and Bumdeling in Trashiyangtse; Gomdar in Samdrup Jongkhar; and Decheling, Zobel, and Nanong in Pemagatshel.

These quantitative findings are consistent with the qualitative assessment, which revealed that farmers overwhelmingly rely on farmyard manure and compost to maintain soil fertility, while chemical fertilizers are applied judiciously due to increasing awareness of their potential long-term effects on soil health, biodiversity, and ecosystem sustainability.

6.7.3 GHG Baseline (Per ProDoc)

For GEF Core Indicator 6, the baseline greenhouse-gas value is taken from the project's Project Document (ProDoc)/PPG-stage estimate rather than re-estimated at baseline, consistent with FAO practice for this project type. The baseline is 0 tCO_2e (no-project condition), with a mid-term target of 63,102 tCO_2e and an end-of-project (final) target of 1,014,297 tCO_2e mitigated. The FAO NEXT tool will be applied during

implementation to establish and update the project's GHG accounting ahead of the Mid-Term Review and Terminal Evaluation, ensuring methodological comparability across reporting points.

6.8 Livelihoods, Income and Value Chains

6.8.1 Income Sources

Agriculture remains the predominant source of HH income across the project areas, supporting approximately 34% of surveyed HH, followed by livestock production (24%) (**Figure 6.20**). Off-farm employment, including wage labour and local construction work, constitutes the third most important livelihood source, accounting for approximately 21% of HH income, while remittances contribute a further 13%. Income derived from forest resources and business activities remains comparatively limited. Across all livelihood categories, annual household earnings are predominantly concentrated within the Nu. 50,000 – 100,000 range, broadly consistent with Bhutan's rural mean per capita income of Nu. 80,578 reported in the 2022 Bhutan Living Standards Survey (BLSS). District-level annual agricultural incomes, however, exhibit considerable variation, ranging from Nu. 16,085 in Lhuentse, Nu. 28,335 in Pemagatshel, Nu. 31,149 in Samdrup Jongkhar, Nu. 37,641 in Mongar, and Nu. 41,463 in Trashiyangtse, to a substantially higher Nu. 95,870 in Trashigang (NSB, 2022). Only a relatively small proportion of households reported annual earnings between Nu. 100,000 and 300,000, while households earning above Nu. 300,000 constituted a very limited share of the sample. These findings suggest that the majority of rural households continue to derive modest incomes, underscoring the importance of strengthening agricultural productivity, market access, and livelihood diversification to enhance household economic resilience.

Spatial variations in livelihood sources reveal that agricultural income is most prominent in Trashigang, Samdrup Jongkhar, Pemagatshel, and Trashiyangtse, while livestock contributes substantially to HH incomes in Samdrup Jongkhar, Trashigang, and Pemagatshel. Forest-based income is concentrated primarily in Samdrup Jongkhar, which also records the highest earnings from business activities. Off-farm employment is particularly significant in Samdrup Jongkhar and Trashigang, whereas remittance income is comparatively higher in Samdrup Jongkhar, Trashigang, and Pemagatshel. In contrast, HH in Mongar and Lhuentse generally exhibit lower income levels across all livelihood sources. At the Gewog level, Minjey (Lhuentse), Silambi (Mongar), Lumang (Trashigang), Ramjar (Trashiyangtse), and Lauri and Martshala (Samdrup Jongkhar) are most economically constrained, reflecting limited livelihood diversification and comparatively weaker income-generating opportunities.

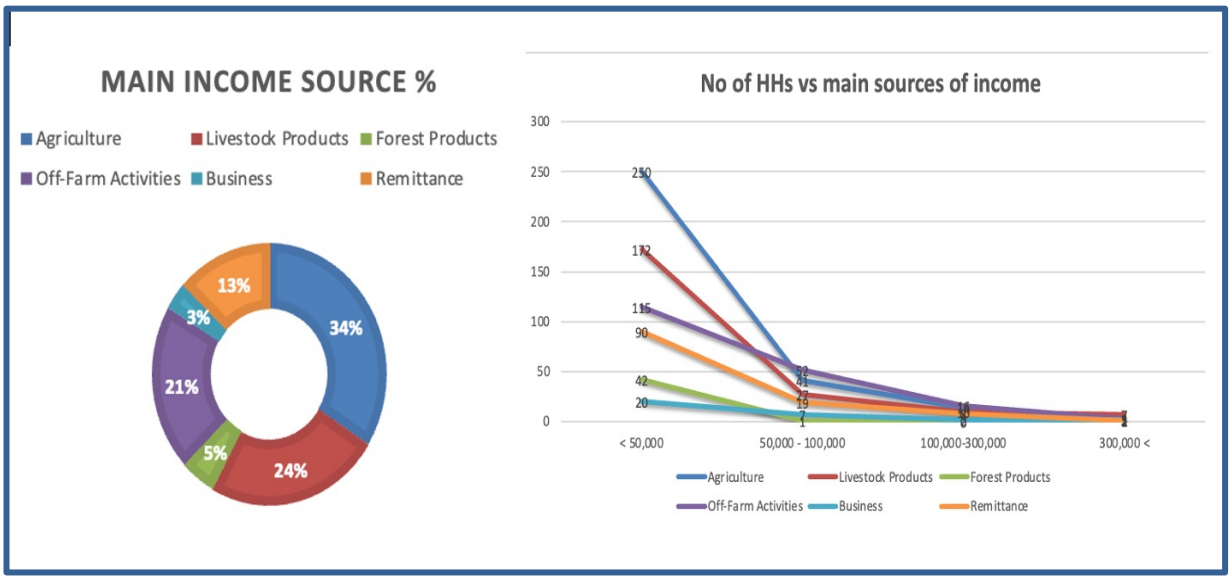


Figure 6.20: HHs income sources and distribution
(Source: Baseline HH Survey, 2026)

The qualitative assessment confirms these findings, indicating that rural HH continue to rely predominantly on integrated crop and livestock production as the foundation of their livelihoods. Income is generated primarily through the sale of dairy products, including milk, butter, cheese, and yoghurt, alongside vegetables, potatoes, maize, wheat, quinoa, poultry products, and, in selected localities, Sichuan pepper.

Over the past three years, HH incomes have remained largely stagnant, with 63% of respondents reporting no noticeable change in their earnings. This pattern was most pronounced in Samdrup Jongkhar, Trashigang, and Trashiyangtse, suggesting limited improvements in livelihood opportunities across these Dzongkhags. Conversely, 22% of respondents reported an increase in HH income, with the highest proportion recorded in Trashigang and Samdrup Jongkhar, reflecting localized improvements in agricultural production, livestock activities, or off-farm employment. Meanwhile, 14% of respondents experienced a decline in income, with Trashigang accounting for the largest share of HH reporting reduced earnings.

6.8.2 Market Participation and Channel

The **Table 6.36** below presents the annual volume of agricultural and livestock products sold by surveyed HH. Overall, the reported sales volumes are comparatively lower than the production levels recorded in the Integrated Agriculture and Livestock Census 2025 (based on 2024 production data) (**Table 6.37**).

Table 6.36: Volume of agricultural and livestock products sold per year based on the survey

Agriculture and Livestock Volume sold (kg/litre/numbers sold/year							
Commodity	**Lhuentse**	**Mongar**	**Pemagatshel**	**S/Jongkhar**	**Trashigang**	**Trashiyangtse**	**Total**
Potato (kg)	1926	5015	47261	6883	47760	0	108845
Maize (kg)	5440	0	60	100	23388	0	28988
Quinoa (kg)	8	1713	23	6	0	6960	8710
Buckwheat (kg)	0	1170	0	1149	0	70	2389
Asparagus (kg/bundle)	0	0	0	0	0	12	12
Beans (kg)	110	260	435	1230	110	30	2175
Broccoli (kg)	381	55	880	0	250	0	1566
Cauliflower (kg)	190	20	1171	0	300	10	1691
Chili (kg)	1432	485	71	0	8725	56	10769
Tomato (kg)	0	100	0	0	0	0	100
Fresh Milk (Litre/bottle)	0	470	6270	6355	27761	765	41621
Cheese (kg)	515	2717	347	8710	5623	0	17912
Butter (kg)	502	1685	179	8700	4928	0	15994
Eggs (piece)	90	10	6800	202	0	900	8002
Chicken (kg)	0	0	0	5	0	0	5

(Source: Baseline HH Survey, 2026)

Table 6.37: Total agricultural and livestock production in the 23 Gewogs

Agriculture and Livestock Census Production based on IALC 2025 (MoAL, 2025)							
Commodity	**Lhuentse**	**Mongar**	**Pemagatshel**	**S/Jongkhar**	**Trashigang**	**Trashiyangtse**	**Total**
Potato (kg)	151,015	765,719	598,721	281,911	2,526,111	1,154,935	5,478,412
Maize (kg)	542,332	918,935	772,332	1,123,195	2,127,044	962,503	6,446,341
Quinoa (kg)	5,540	1,407	189	-	2,489	3,202	12,827

Buckwheat (kg)	259	21,596	16,599	74,461	100,262	349	213,526
Asparagus (kg)	434	68	430	151	13,006	1,581	15,670
Beans (kg)	19,256	51,705	30,642	42,084	136,594	38,966	319,247
Broccoli (kg)	6,407	15,092	11,752	16,541	39,227	28,739	117,758
Cauliflower (kg)	6,894	10,324	11,136	13,084	33,483	16,450	91,371
Chili (kg)	5,721	5,975	4,887	6,097	8,614	11,058	42,352
Tomato	1,795	447	2,061	2,773	3,076	1,705	11,857
Fresh Milk (l)	509,976	495,448	719,491	881,808	4,627,542	614,326	7,848,591
Cheese (kgs)	40,031	41,793	43,830	46,537	83,099	28,546	283,836
Butter (kgs)	25,758	22,886	24,633	31,567	222,722	48,276	375,842
Eggs (Nos)	490,257	282,691	509,842	497,322	672,830	381,065	2,834,007
Chicken (kgs)	17	372	245	1,817	1,894	318	4,663

(Source: Integrated Agriculture and Livestock Census (IALC), 2025)

Additionally, as part of the baseline assessment, farm-gate prices for the commodities collected through the HH survey were compared with prices published in the Agricultural Market Information System (AMIS) (**Table 6.39)**. However, the comparison was constrained by outdated AMIS records, with the most recent data available only up to October 2025 for a few Dzongkhags, while price information for several others had not been updated since 2021. Qualitative findings nevertheless indicate that limited market access, inadequate market information, and weakly organized marketing systems constrain producers from obtaining fair and remunerative prices. Comparative analysis further reveals that vegetable prices exhibit greater spatial variation than livestock products, with commodity prices in Thimphu generally exceeding those recorded in the surveyed Dzongkhags, reflecting stronger market demand and higher purchasing power in the capital.

Table 6.38: Average farmgate prices of agriculture and livestock products

	Agriculture and Livestock Average price in Nu (kg/litre/tray/numbers)					
	Farmgate price					
Commodity	Lhuentse	Mongar	Pemagatshel	S/Jongkhar	Trashigang	Trashiyangtse
Potato (kg)	20-40	6-25	20	25-50	19-30	0
Maize (kg)	25-45	0	25	30	10-50	0
Quinoa (kg)	0	5-420	80	1	0	100-150
Buckwheat (kg)	0	35-60	0	10-120	0	50-100
Asparagus (kg) bundle	0	0	0	0	0	90
Beans (kg)	30-100	20-70	25-100	35	10-30	40-45
Broccoli (kg)	20-50	30-40	30-40	0	15-50	0
Cauliflower (kg)	20-50	30	30-40	0	15-20	60
Chili (kg)	25-200	40-100	40-80	0	40-100	60-65
Tomato (kg)	0	15-30	0	0	0	0
Fresh Milk (l/bottle)	0	40-55	35-40	40-100	40-55	30-100
Cheese (kg)	20-125	50-400	300-450	40-350	250-600	0
Butter (kg)	100-360	330-550	300-450	400-625	300-450	0
Eggs / tray	450	450	480-500	600	450-600	360
Chicken (kg)	0	0	0	500	0	0

(Source: Baseline HH Survey, 2026)

Table 6.39: Published AMIS market prices for Thimphu and four project Dzongkhags

Market price (AMIS System) Assessed 6 July 2026[1] (MoAL, 2026)					
Agriculture and Livestock Average price in Nu (kg/litre/tray/numbers)					
	Aug-25	**Oct-25**	**Apr-24**	**Dec-23**	**Oct-25**
Commodity	**Thimphu**	**Mongar**	**S/Jongkhar**	**Trashigang**	**Trashiyangtse**
Potato (kg)	40	43	40	36	38
Maize (kg)	-	-	-	-	-
Quinoa (kg)	-	-	-	-	-
Buckwheat (kg)	190	150	-	-	-
Asparagus (kg)	170	450	-	-	-
/bundle)	180	100	100	73	110
Broccoli (kg)	140	100	-	-	-
Cauliflower (kg)	155	100	-	-	-
Chili (kg)	100	100	120	150	100
Tomato (kg)	45	100	40	93	80
Fresh Milk (l/bottle)	100	60	60		75
Cheese (kg)	550	500	450	350	425
Butter (kg)	500	-	-	470	425
Eggs / per egg	20	12	14	-	16.45
Chicken (kg)					

(Sources: https://amis.systems.gov.bt/lastmarket.php)

6.8.3 Market Channels and Export Orientation

Market pathways for agricultural and livestock products remain relatively fragmented, with farmers relying on a combination of direct marketing, aggregators, cooperatives, processors, institutional buyers, and, to a limited extent, export markets. Overall, marketing is dominated by local and Dzongkhag-level trade, with dairy products frequently channelled through farmers groups and milk processing units, reflecting limited integration into more structured value chains (**Figure 6.21**).

Aggregators represent the principal marketing channel, accounting for 37% of all sales, with the highest concentration in Samdrup Jongkhar, Trashigang, and Pemagatshel, and the lowest in Mongar (**Figure 6.21**). Direct marketing by farmers constitutes 36% of total sales, primarily through local markets (31%) and, to a lesser extent, Dzongkhag markets (5%), particularly in Lhuentse, Mongar, and Trashiyangtse. Institutional market linkages remain modest at 6%, concentrated in Tsaenkhar (Lhuentse), Drepong and Silambi (Mongar), Lauri and Martshala (Samdrup Jongkhar), and Khaling (Trashigang). Linkages with processing companies are extremely limited, representing only 2% of respondents and confined to Trashigang, while cooperative marketing was recorded only in Khaling Gewog. Direct exports account for approximately 4% of total agricultural sales, originating primarily from Merak, Sakteng, Khaling, and Lumang in Trashigang; Serthi in Samdrup Jongkhar; and Bumdeling and Ramjar in Trashiyangtse. These findings highlight the need to strengthen agriculture value chains, promote quality assurance, and support market-oriented production Exported commodities comprise high-value agricultural and livestock products, including cardamom, ginger, potatoes, maize, chilli, vegetables, dairy products (particularly butter and cheese), and yak products, to neighbouring eastern Dzongkhags of India serving as the principal export destination.

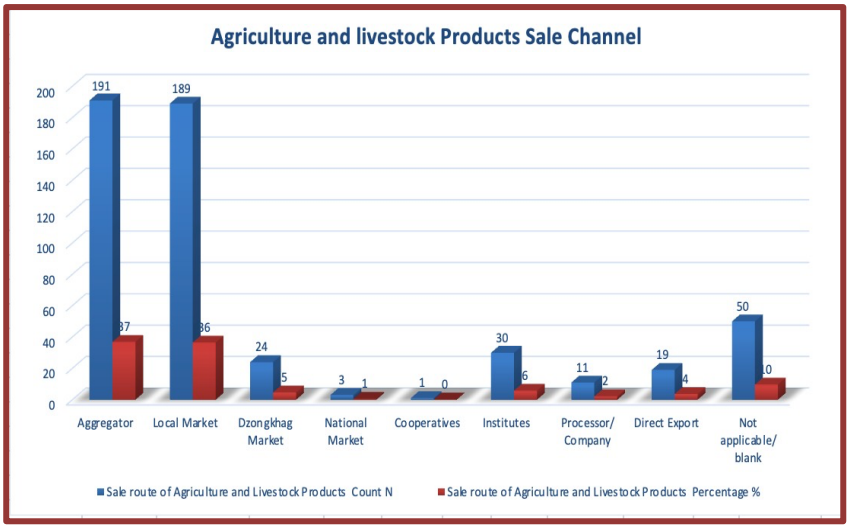


Figure 6.21: Market channels for agriculture and livestock products
(Source: Baseline HH Survey, 2026)

These findings indicate that agricultural marketing remains largely localized and intermediary-driven, highlighting the need to strengthen aggregation systems, processing capacity, cooperative marketing, and institutional and export market linkages to enhance value addition and improve producer returns.

6.8.4 Access to Market and Market Information

Access to local markets is generally favourable across the project area. Overall, 57% of respondents reported that they can reach their nearest local market by vehicle in less than one hour, while 32% require between one and three hours, and only 11% travel for more than three hours (**Figure 6.22**).

Market accessibility varies considerably across Dzongkhags. More than three-quarters of respondents in Samdrup Jongkhar, Mongar, and Trashiyangtse reported reaching local markets within one hour, indicating relatively strong road connectivity. In contrast, just over half of respondents in Trashigang and Lhuentse enjoy similar access. Pemagatshel recorded the weakest market connectivity, with only 13% of respondents reaching local markets within one hour, while 77% require one to three hours of travel. Long-distance travel exceeding three hours is most prevalent in Trashigang (22%), followed by Pemagatshel (10%) and Samdrup Jongkhar (9%), whereas such travel is comparatively uncommon in Mongar and Trashiyangtse (2% each).

The most remote communities include villages and chiwogs in Kangpar, Lumang, and Sakteng Gewogs of Trashigang, Martshala Gewog in Samdrup Jongkhar, and Nanong Gewog in Pemagatshel, where farmers typically travel for more than three hours by road to access local markets.

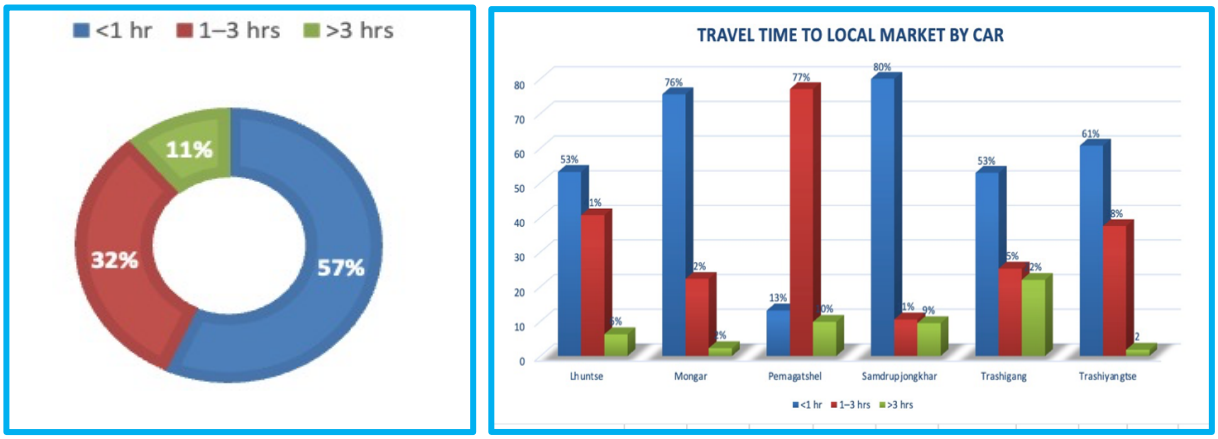


Figure 6.22: Spatial variation in travel time by car to the nearest local market
(Source: Baseline HH Survey, 2026)

Access to market price information remains limited across the project area, with only 39% of surveyed HH reporting that they receive market price information, while a substantial 61% lack access (**Figure 6.23**). This finding highlights the need to establish effective market information system to support informed marketing decisions. Relatively better access was reported in Pemagatshel, Lhuentse, and Trashigang, whereas access was poorest in Trashiyangtse and Mongar. More than three-quarters of respondents in Mongar (76%) and Trashiyangtse (75%), along with 73% in Samdrup Jongkhar, indicated that they do not receive market price information. The information gap is particularly pronounced in the Gewogs of Drepong, Jurmed, and Silambi in Mongar; Bumdeling, Khamdang, and Ramjar in Trashiyangtse; and Lauri, Martshala, and Serthi in Samdrup Jongkhar.

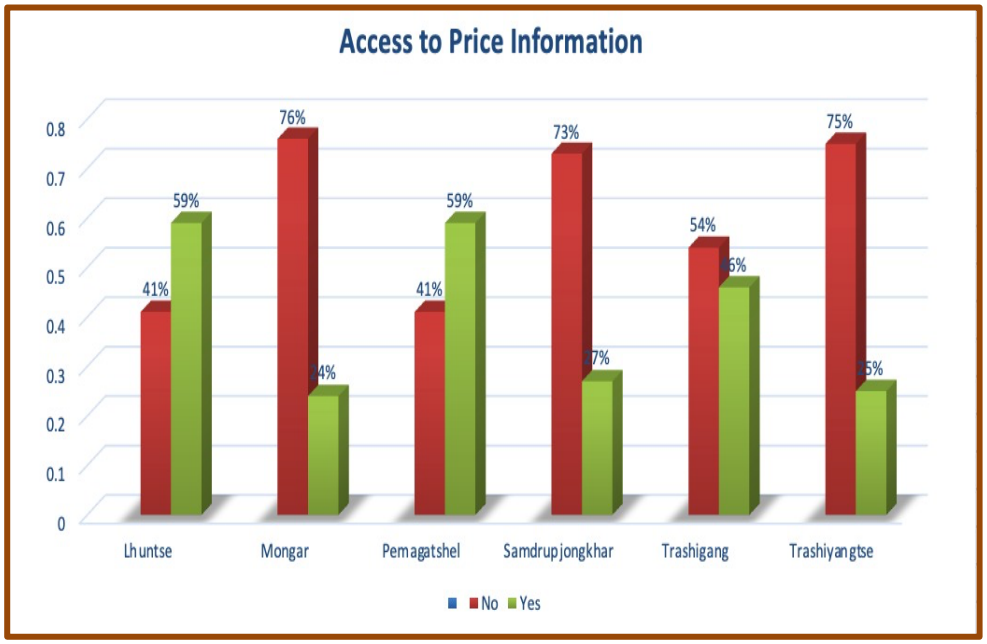


Figure 6.23: Spatial variation in access to market price information
(Source: Baseline HH Survey, 2026)

The qualitative assessment and AMIS records (discussed earlier) reinforces these findings, revealing that farmers primarily depend on local traders, fellow farmers, and informal community networks for market information. Respondents further noted that the limited price information available is often outdated or inconsistent with prevailing market conditions, constraining their ability to make informed production and marketing decisions.

6.8.5 Value Chain Constraints

Marketing and selling of agricultural and livestock products continue to be constrained by a combination of structural and market-related challenges. The HH survey identified low farm-gate prices (34%) as the most significant constraint, followed by the lack of reliable buyers (28%), inadequate transport facilities (10%), and insufficient cold storage infrastructure (9%), among other challenges (**Figure 6.24**).

While low prices and limited market demand are pervasive across all six project Dzongkhags, transport bottlenecks and inadequate cold storage facilities are particularly pronounced in Tsaenkhar (Lhuentse); Narang and Silambi (Mongar); Decheling and Nanong (Pemagatshel); Kangpar and Sakteng (Trashigang); and Bumdeling and Khamdang (Trashiyangtse), where remoteness further constrains market participation.

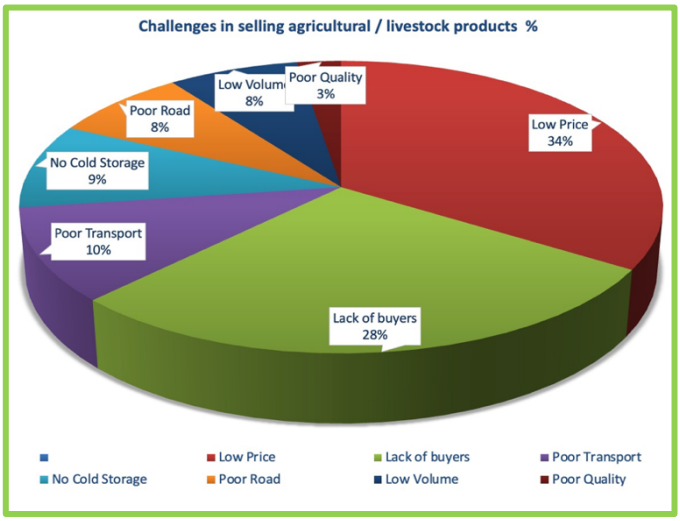


Figure 6.24: Challenges in marketing agriculture and livestock products
Source: Baseline HH Survey, 2026)

These findings are consistent with the qualitative assessment, which revealed that farmers face multiple marketing constraints, including unreliable market access, volatile farm-gate prices, inadequate transport and aggregation services, seasonal market gluts, and weak linkages with institutional buyers. Collectively, these challenges undermine farmers' bargaining power, reduce profitability, and contribute to increased post-harvest losses.

The survey found that 59% of respondents estimated post-harvest losses to be below 10%, while 26% reported losses between 10% and 25% (**Figure 6.25**). This finding highlights the need to invest in improved storage, cold-chain facilities, and agro-processing infrastructure to reduce losses, add value, and increase farm profitability. Higher levels of loss were less common, with 21% estimating losses of 25–50% and 18% reporting losses exceeding 50%. Dzongkhag-level analysis indicates that relatively lower post-harvest losses were more frequently reported in Trashigang, Lhuentse, and Samdrup Jongkhar, whereas Lhuentse and Trashiyangtse recorded the highest incidence of losses exceeding 50% (**Table 6.40**).

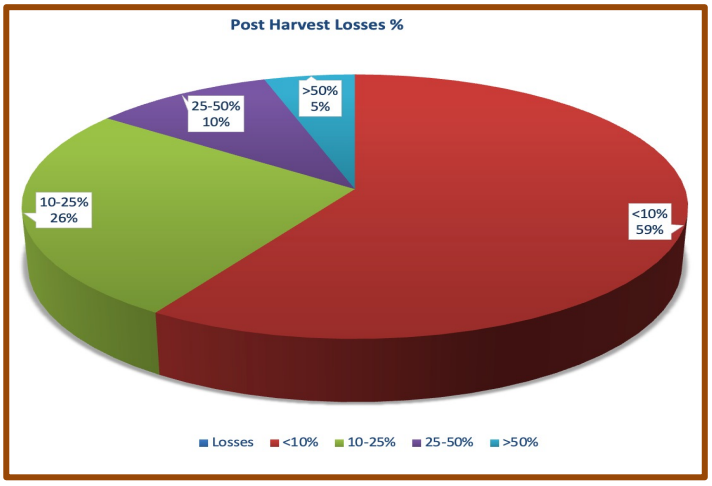


Figure 6.25: Variation in post-harvest losses
(Source: Baseline HH Survey, 2026)

Table 6.40: Geographic distribution of post-harvest losses

Post-Harvest losses						
Percentage Losses	**Lhuentse**	**Mongar**	**Pemagatshel**	**S/Jongkhar**	**Trashigang**	**Trashiyangtse**
<10%	72%	56%	43%	62%	73%	38%
10-25%	16%	24%	49%	29%	17%	23%
25-50%	0	16%	8%	7%	8%	21%
>50%	13%	4%	0%	1%	2%	18%

(Source: Baseline HH Survey, 2026)

Qualitative findings attribute these losses primarily to inadequate storage facilities, pest and disease infestation during storage, and limited cold chain infrastructure. Together, these constraints reduce product quality, limit market opportunities, and weaken the efficiency and competitiveness of agricultural value chains while diminishing farmers' incomes.

6.8.6 Value Addition Practices

Overall, the value addition remains limited across the project Dzongkhags, with only 25% of HH doing some form of processing, while the remaining 75% market their agricultural and livestock products in raw or unprocessed form. The weak market integration highlights the need to strengthen agricultural value chains, promote quality assurance, and support market-oriented production. Spatially, value addition is mostly done in Trashigang (35%) and Pemagatshel (27%), followed by Mongar (18%) and Trashiyangtse (14%), whereas Lhuentse and Samdrup Jongkhar each account for only 3%, reflecting significant geographical disparities in agro-processing capacity (**Figure 6.26**).

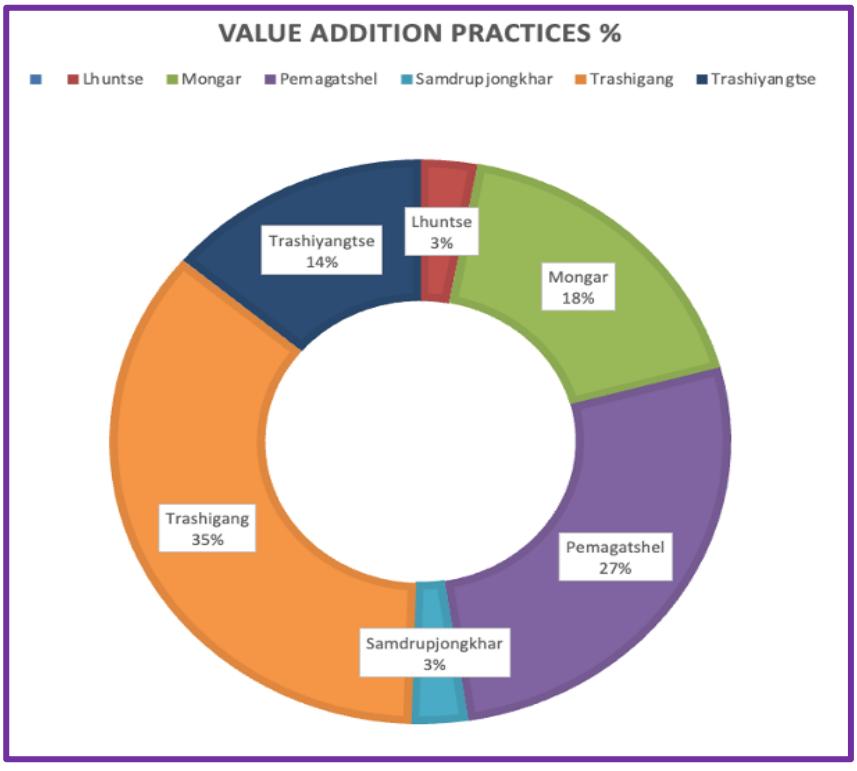


Figure 6.26: Variation in value addition practices across project Dzongkhags
(Source: Baseline HH Survey, 2026)

The qualitative assessment corroborates these findings, revealing that existing value addition is largely confined to basic dairy processing, including butter and cheese production, while processing of agricultural crops remains minimal due to inadequate processing equipment, packaging and grading facilities, cold storage, and limited access to modern agro-processing technologies.

One notable exception is the Khaling Youth Integrated Agricultural Initiative, which manages a 10-acre integrated farm producing buckwheat, mustard, and seasonal crops, supported by a 300 MT cold storage facility that helps reduce post-harvest losses, improve product quality, and facilitate year-round market supply for farmers across eastern Bhutan, which unfortunately is underutilized (BBS, 2024) as it is the case with many similar facilities across the country.



Figure 6.27: Cold Storage, Khaling, Trashigang. Photo Courtesy @ BBS

Similarly, agro-processing infrastructure (19%) remains limited across the project Dzongkhags, with Trashigang exhibiting the highest concentration of processing facilities owing to the presence of several established enterprises within or in close proximity to the surveyed Gewogs. Notable facilities include Koufuku International Limited (KIL) dairy processing plant at Chenari under Samkhar Gewog, which provides an important market outlet for dairy producers, particularly from nearby Yangneer Gewog; the Lumang Gewog Food Processing Unit, which processes locally produced potato, maize, buckwheat, barley, sweet potato, and cassava into a range of value-added products such as chips, cookies, candies, pickles, and cereal and vegetable-based pastes; and the Khaling Youth Integrated Agricultural Initiative, which operates a 300 MT cold storage facility.

Other notable processing facilities identified within the surveyed Gewogs include the Minjey Dairy Processing Unit in Lhuentse, producing butter, cheese, curd, paneer, and yoghurt; the Rural Youth Processing and Marketing Enterprise under the Samjong Initiative in Gomdar, Samdrup Jongkhar, producing buckwheat noodles and bread on a small scale; the Druk Arachis Peanut Processing Facility at Doksum, Khamdang Gewog, Trashiyangtse, producing roasted peanuts and peanut butter; and the Woongchilo Dairy Group in Nanong, Pemagatshel, engaged in dairy processing.

Beyond the surveyed locations, further consultations identified several additional processing facilities across the project Dzongkhags, including the Lingmethang Integrated Horticulture Farm and Mongar Dairy Processing Plant in Mongar, Kurtoed Food Processing Unit and Sertsham Milk Processing Plant in Lhuentse, Urka Bangla Processing Plant in Trashiyangtse, and the FMCL Paddy Processing Plant in Samdrup Jongkhar.

A particularly significant regional asset is the Nganglam Export and Import Facilitation Centre in Pemagatshel, which provides sorting, grading, packaging, and aggregation services for export-oriented commodities such as

cardamom, ginger, and citrus. This facility is further complemented by the Tsatshi Guram Processing Unit, Denchi Integrated Farmers' Market, and Dungsam Integrated Fruit Processing Plant, collectively strengthening value chain development, reducing post-harvest losses, and enhancing market access for agricultural producers across eastern Bhutan.

Certification of agricultural and livestock products remains one of the most significant constraints facing Bhutan's agri-food sector, particularly for producers in eastern Bhutan, with only 7% of surveyed respondents reporting that their products are certified. The limited instances of certification were primarily reported from Khamdang Gewog in Trashiyangtse, largely relating to Good Agricultural Practices (GAP) and organic farming certification.

The qualitative assessment reinforces these findings, indicating that limited access to certification restricts product branding, market differentiation, value addition, and compliance with food safety standards, thereby reducing producers' ability to access premium domestic and export markets.

6.9 Food Security and Nutrition

6.9.1 HH Food Sufficiency

HH food sufficiency in the project area is moderate and strongly seasonal. Asked for how many months of the year their own farm production is sufficient to meet HH food needs, 65% of surveyed HH reported seven months or more and can be considered food-sufficient, while 35% reported six months or less and are food-in sufficient (**Figure 6.28**). This highlights the need to improve agricultural productivity, post-harvest storage, and household resilience to seasonal food shortages. Almost half of all HH achieve near or full self-sufficiency (30%) for 10–12 months and a further 20% for more than twelve months yet 17 % can meet their needs from own production for less than three months and another 18 % for only three to six months. Own production remains the single largest food source for just over half of HH (52%), with market purchase almost equally important (48%) and forest collection negligible (0%), indicating that most HH straddle subsistence and market-dependent food systems (**Table 6.41**). Food sufficiency varies markedly across Dzongkhags: Trashigang is by far the most food-secure (85% self-sufficient for seven months or more), followed by Mongar (67%) and Samdrup Jongkhar (64 %), whereas Trashiyangtse (39%) and Pemagatshel (48%) are the most food-insecure (**Table 6.42**).

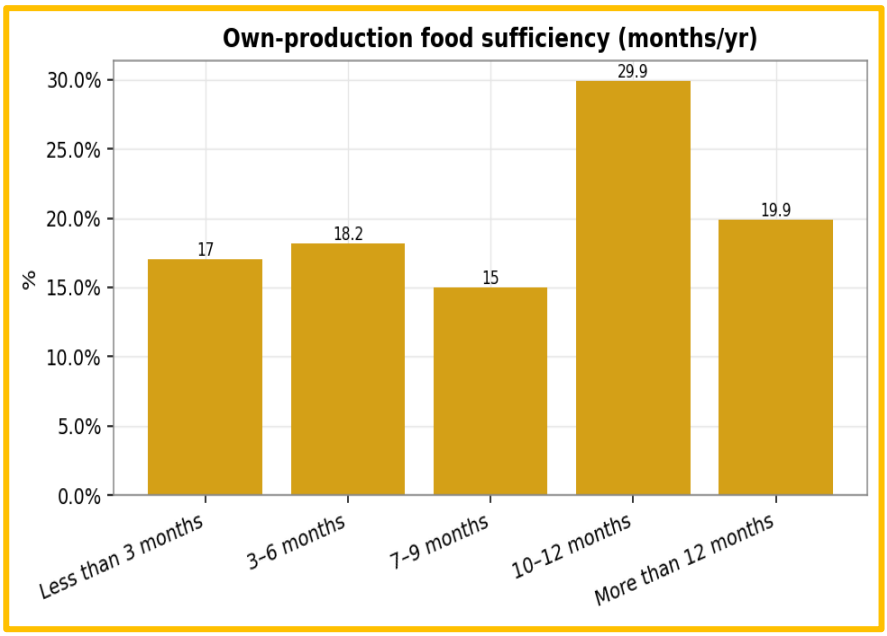


Figure 6.28: Own -production food self-sufficiency (n=412)
(Source: Baseline HH Survey, 2026)

Table 6.41: Main food sources

Main food source	n	%
Own production	215	52
Purchase from market	196	48
Collection from forest	1	0

(Source: Baseline HH Survey, 2026)

Table 6.42: Own production food self-sufficiency by Dzongkhags

Dzongkhag	Sample Size (n)	Less than 3 months (%)	3–6 months (%)	7–9 months (%)	10–12 months (%)	More than 12 months (%)
Lhuentse	32	28	9	0	6	56
Mongar	45	24	9	9	31	27
Pemagatshel	61	21	31	31	13	3
S/Jongkhar	95	7	28	25	22	17
Trashigang	123	6	9	11	49	26
Trashiyangtse	56	41	20	4	32	4
Overall (n=412)	**412**					

(Source: Baseline HH Survey, 2026)

6.9.2 Seasonal Food Insecurity

Acute food shortage is less widespread than chronic insufficiency but remains a real concern for a minority of HH (**Table 6.43**). Over the past twelve months, 12% of HH (48 of 412) reported experiencing an outright food shortage. Among those affected, the shortage most commonly lasted three to six months 52% (25 HH) or less than three months 29% (14 HH), with a small number experiencing longer and more severe shortfalls of seven months or more. This pattern of short-duration shortages concentrated in the lean pre-harvest months reflects the dependence of these farming systems on a single main cropping season and on own production that, for many HH, falls well short of the full year. It underlines the importance of interventions that extend food availability across the year, including improved on-farm storage, post-harvest loss reduction, crop diversification, and stronger market access to smooth seasonal gaps in food supply.

Table 6.43: Food shortages duration

Indicator	Food Shortages(n=412)				Duration of Food Shortages(n=48)				
Responses	Yes(n)	Yes (%)	No(n)	No (%)	Less than 3 months (%)	3–6 months (%)	7–9 months (%)	10–12 months	More than 12 months
	48	12	364	88	29	52	10	4	4

(Source: Baseline HH Survey, 2026)

6.9.3 Dietary Diversity and Nutrition

Dietary diversity is limited. Based on a 24-hour consumption recall across the eight food groups captured by the survey, the mean HH Dietary Diversity Score (HDDS) was four out of eight, meaning that a typical HH consumed only about half of the assessed food groups on the preceding day (**Figure 6.29**). Diets are dominated by vegetables (consumed by 98% of HH), oils and fats (66%), sugar and sweets (58%) and cereals (55%), while protein-rich and micronutrient-dense groups are eaten by only a minority: dairy (42%), meat, fish and eggs (38%), fruits (36%) and, most strikingly, pulses and legumes (13%) (**Table 6.44).** This profile points to diets that are broadly energy-adequate but limited in protein and micronutrient diversity. Dietary diversity mirrors the food-sufficiency pattern spatially, ranging from a mean HDDS of 5.2 in Trashigang to 3.2–3.5 in Samdrup Jongkhar, Pemagatshel and Trashiyangtse. On the production side, 70% of HH grow at least one crop specifically to improve nutrition i.e., most commonly vegetables (67%) and fruits (48%), with

nuts (19%), millet (9%) and quinoa (1%) less common, providing an existing platform on which the project's nutrition-sensitive agriculture and diversification interventions can build on (**Table 6.45**). The mean HDDS suggest limited food production, nutrition education, and improved access to nutritious foods. At the same time, the fact that 70% of households already cultivate nutrition-sensitive crops provides a strong foundation for expanding diversified and nutrition-sensitive farming systems. In addition, 12% of households reporting food shortages indicates the need to strengthen community food reserves, improve market access, and enhance livelihood opportunities to increase food availability and resilience throughout the year.

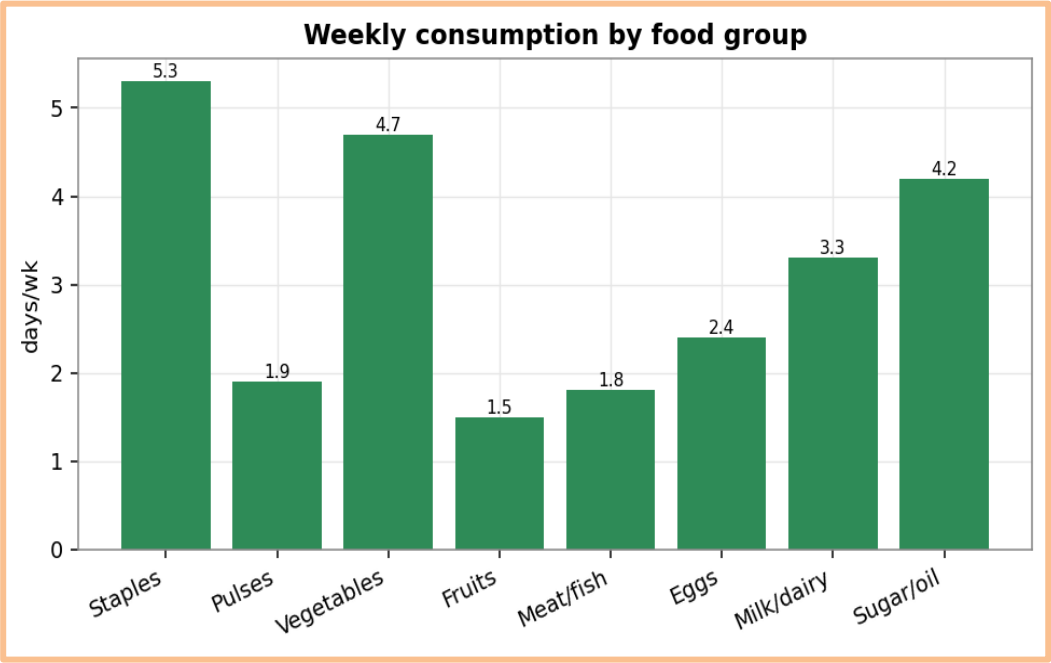


Figure 6.29: Weekly consumption by food group (n=412)
(Source: Baseline HH Survey, 2026)

Table 6.44: Foods consumed in last 24 hours

Food Group	Cereal (%)	Pulses/Legume (%)	Vegetables (%)	Fruits (%)	Meat/Fish/Eggs (%)	Dairy Products (%)	Oil/Fats	Sugar/Sweets (%)
Responses	55	13	98	36	38	42	66	58

(Source: Baseline HH Survey, 2026)

Table 6.45: Foods grown to improve nutrition

Indicator	Growing food to improve nutrition (n=412) (%)		Type of foods grown to improve nutrition(n-=289)				
Responses	Yes (%)	No (%)	Millet (%)	Quinoa (%)	Fruits (%)	Nuts (%)	Vegetables (%)
Yes	70	30	13	2	69	28	95

(Source: Baseline HH Survey, 2026)

6.10 Gender, Youth and Social Inclusion

6.10.1 Decision-making

Women hold strong agency over farm decisions (**Figure 6.30**). Women are the sole decision-maker more often than men for crop selection (43% vs 21%), land preparation and harvesting (40% vs 24%), input purchase (35% vs 26%) and HH food expenditure (35% vs 29%). Joint decision-making is also high across all domains (35–42%), and men lead women only marginally on major farm investments (32% vs 29%). Women are therefore

central agents, not passive beneficiaries, and should be primary participants in project planning, training and value-chain interventions.

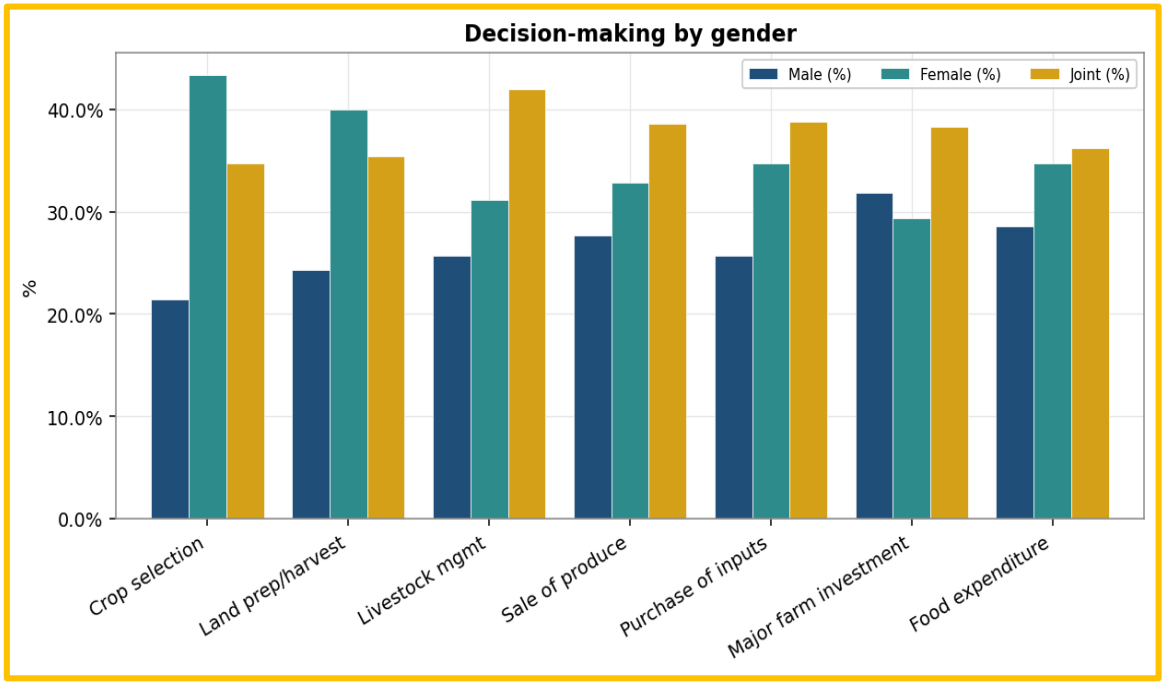


Figure 6.30: HH decision-maker by domain and gender
(Source: Baseline HH Survey, 2026)

6.10.2 Labour, Training and Access

Women contribute slightly more farm labour than men (22 vs 21 hours per week on average) (**Table 6.46**), reinforcing their central productive role, while youth (1.5 hours) and persons with disability (1.7 hours) contribute little consistent with youth out-migration and the limited engagement of persons with disability. Although women contribute lightly more time to agricultural activities than men indicating a relatively high labour burden, the relatively high proportion of women with equal access to productive resources such as land and credit provides a strong foundation for promotion women's economic empowerment and leadership in sustainable agriculture.

Table 6.46: Mean weekly farming hours by group and Dzongkhag

Indicator	Overall	Lhuentse	Mongar	Pemagatshel	S/Jongkhar	Trashigang	Trashiyangtse
Women	21.8	4.6	28.6	22.8	24	19.6	25.8
Men	21.1	6	19.4	27.6	23.7	14.7	33.4
Youth	1.5	0.3	2.9	0.2	2.2	1	2.2
Person w/disability	1.7	0	8.3	1	4.8	0.1	0

(Source: Baseline HH Survey, 2026)

Despite women's central role, training coverage is very low: only 6% of HH report women receiving agricultural or livestock training in the past 12 months, falling to 2% for youth and just 0.2% for persons with disability. Perceived equal access to credit and land follows the same gradient, 73% for women, 38% for youth and only 20% for persons with disability (**Table 6.47**). These gaps translate into clear, measurable Gender Equality, and Social Inclusion targets: scaling women's training from a very low base and addressing the pronounced exclusion of youth and persons with disability, underscoring the need for targeted capacity-building and dedicated inclusion-strategies.

Table 6.47: Equal access and training by group

Indicator	n	Yes(n)	Yes (%)
Women: equal access to credit/land	412	300	73
Youth: equal access	412	156	38
PWD: equal access	412	83	20
Women: training received (12 months)	412	25	6
Youth: training received (12 months) equal access		6	2

(Source: Baseline HH Survey, 2026)

6.11 Institutional Support and Extension Services

This section assesses the baseline status of institutional support and extension services rendered by both government agencies and community-based institutions to promote sustainable agriculture and livestock production. The analysis focuses on three key indicators: membership in groups and cooperatives, access to extension service, and awareness of government programs and project support and also provides qualitative insights into coordination mechanisms.

6.11.1 Membership in Groups and Cooperatives

The baseline findings indicate moderate levels of community participation among surveyed HH, although a substantial proportion remain unaffiliated with any formal community organization (**Figure 6.31**). Overall, 40% of HH reported having no membership in any community-based group, suggesting limited access to collective platforms for information sharing, resource management, and community decision-making. This finding is consistent with broader evidence of weak institutional reach and limited organizational capacity in rural Bhutan (Wangmo et al., 2021a; Wangmo et al., 2021b).

Among participating HH, Community Forest Groups (CFG) were the most common form of membership (34%), followed by Road User Groups (RUG) (26%). Membership in Farmer Group (FG) and Water User Associations (WUA) was reported by 24% of HH each, highlighting the importance of collective action in natural resource management, agriculture production, and rural infrastructure development.

Despite their importance, participation in FG remains moderate. Literature indicates that while many FGs perform reasonably well in production activities, they face challenges related to governance, marketing, organizational management, and member retention (Wangmo et al., 2021a). FGD and KII findings corroborate these challenges, noting declining membership due to rural outmigration, ageing populations, competing group structures, weak ownership, and limited post-formation support.

Cooperative membership was particularly low, with only 3% of HH reporting participation, aligning with national studies indicating limited membership growth and governance and management challenges (Choden et al., 2022). FGDs and KIIs further indicated that cooperatives remain relatively uncommon across the project landscape, with FGs serving as the more prevalent institutional arrangement.

Combined participation in FG and cooperatives (27%) signals weak institutional reach in agriculture and livestock sectors. Both the literature and qualitative findings indicate that inadequate governance, weak local ownership, limited access to finance, technology, and markets, and insufficient post-establishment support continue to constrain the effectiveness and sustainability of these organizations (Wangmo et al., 2021b; Shangshon et al., 2023). However, the prominence of CFGs, RUGs, FGs, and WUAs provide an existing platform for project implementation, community mobilization, and knowledge dissemination. Qualitative findings suggest that non-membership is often linked not only to institutional weaknesses but also to geographic isolation, limited awareness, and insufficient outreach, with many respondents expressing interest in joining groups if provided with adequate awareness, training, and facilitation support. Strengthening governance, leadership, member capacity, market linkages, access to finance and technology, and long-term institutional support will be critical to improving participation, enhancing the sustainability of community-

based organizations, and strengthening rural livelihood resilience (Dorji & Gurung, 2022a; Dorji & Gurung, 2022b).

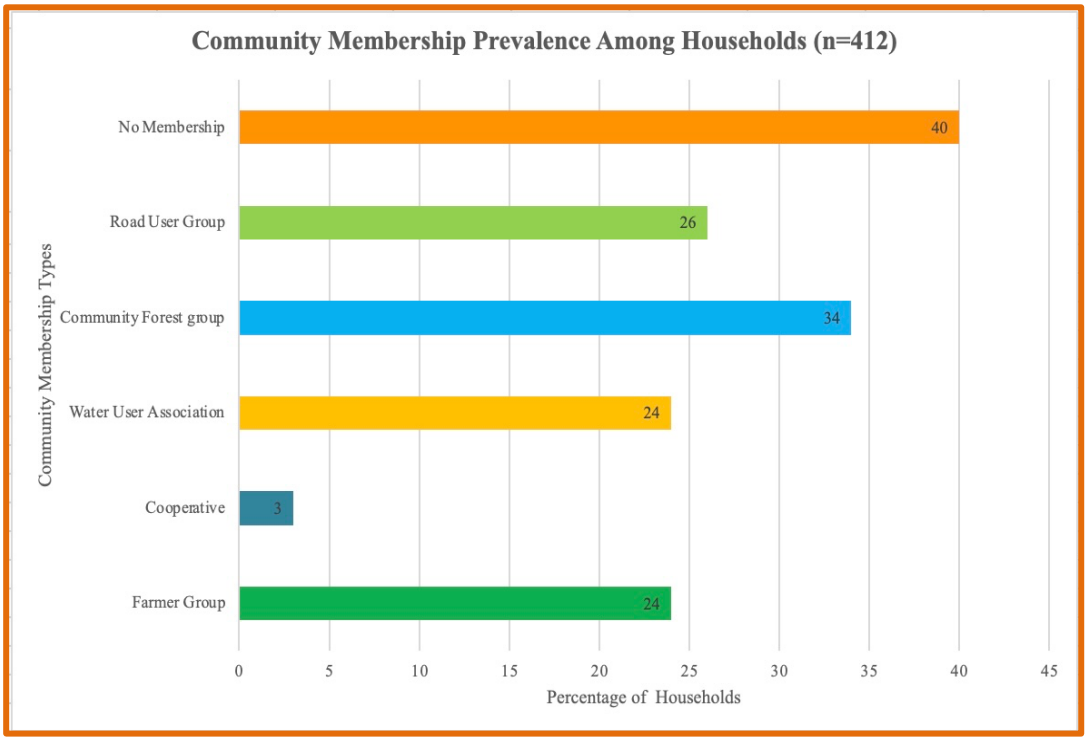


Figure 6.31: Community membership prevalence among HH
(Source: Baseline HH Survey, 2026)
***Note:** Percentages sum to more than 100% because HH may belong to multiple community groups*

Significant variation in community group participation exists across the six project Dzongkhags (**Table 6.48**). Pemagatshel exhibited the highest level of community participation, with exceptionally high membership in RUG was (93%), followed by WUAs (62%), and CFGs (43%). Correspondingly, only 5% of HH reported having no community membership.

Mongar also demonstrated relatively high engagement, with substantial participation in CFGs (42%) and WUAs (38%), and only 24% of reporting no membership.

In contrast, Lhuentse and Trashiyangtse recorded the highest proportions of HH without membership, at 66% and 71%, respectively. Participation in WUAs and RUG was absent in both Dzongkhags, while FG and CFGs membership remained comparatively low, indicating more limited institutional engagement.

Samdrup Jongkhar displayed moderate participation levels, with CFGs (39%) being the most common membership type, followed by WUAs (25%) and RUG (23%). However, 44% of HH reported no membership.

Trashigang, which accounted for the largest sample size, showed relatively strong participation in FG (32%) and CFGs (29%), while cooperative membership was among the highest observed (5% each). However, 39% of HH remained unaffiliated.

Overall, community-based organizations are relatively well-established in Pemagatshel and Mongar, while participation remains comparatively low in Lhuentse and Trashiyangtse. These variations highlight differing levels of community organization and institutional engagement across the project Dzongkhags, with important implications for project implementation and targeting of community-based interventions.

Table 6.48: Community membership prevalence among HH by Dzongkhag (n = 412)

Dzongkhag	Sample Size (n)	Farmer Group (%)	Cooperative (%)	WUA (%)	CFG (%)	Road User Group (%)	No Membership (%)
Lhuentse	32	16	0	0	19	0	66
Mongar	45	20	2	38	42	27	24
Pemagatshel	61	31	0	62	43	93	5
S/Jongkhar	95	15	3	25	39	23	44
Trashigang	123	32	5	15	29	14	39
Trashiyangtse	56	25	5	0	25	0	71
Overall	**412**	**24**	**3**	**24**	**33**	**26**	**40**

(Source: Baseline HH Survey, 2026)
Note: *Percentages exceed 100% across membership categories because HH may belong to more than one community group* (*Multiple Responses).*

6.11.2 Access to Extension Services and Frequency of Visits

The baseline findings indicate that agricultural and livestock extension services have a relatively broad presence across the project landscape, with 70% of reporting access to extension services and 30% reported no access (**Figure 6.32**). While this suggests relatively broad service coverage, the frequency of contact remains limited. Most HH reported receiving extension visits half-yearly (33%) or on an ad-hoc basis (29%), while only 14% received monthly visits, 12% quarterly visits, and just 2% weekly visits (**Figure 6.32**). In addition, 10% of HH indicated that extension agents had never visited their farms. These findings suggest that that although extension services reach many households, engagement is generally irregular, limiting opportunities for continuous technical support, monitoring, and follow-up.

The survey findings are consistent with the literature, which indicates that although Bhutan's extension system has contributed to improvements in crop and livestock production and natural resources management, its effectiveness is constrained by limited staffing, weak market-oriented advisory services, inadequate monitoring, and capacity gaps among extension personnel (Shangshon et al., 2023; Wangmo et al., 2021a; Wangmo et al., 2021b; Rigyal & Wongsamun, 2011). Previous studies further show that extension outcomes depend not only on service coverage but also on the quality, frequency, and continuity of engagement, and that resource-endowed farmers often benefit more than smallholders due to differences in landholding, labour availability, and market connectivity (Shangshon et al., 2023; Kuenga & Gurung, 2022).

FGD and KII findings strongly reinforce these observations. Across most project areas, respondents described extension services as reactive, with visits often occurring only during disease outbreaks, or seasonal activities, or upon farmer requests rather than through regular field engagement. Participants also highlighted inadequate follow-up, delayed delivery of agricultural inputs, limited market support, and shortages of extension personnel, particularly in remote areas where individual extension officers often serve multiple Gewogs while undertaking administrative responsibilities. These constraints reduced farmers' awareness of available services and confidence in seeking technical assistance. Conversely, some communities reported positive experiences where dedicated extension staff conducted regular field visits and provided timely technical advice, demonstrating the benefits of adequate staffing and sustained engagement.

The findings clearly suggest that the key challenge lies less in expanding service coverage than in improving the frequency, quality, and continuity of extension support. Strengthening human resource capacity, expanding outreach to remote communities, enhancing market-oriented advisory services, investing in continuous professional development for extension personnel, and promoting decentralized and digital extension approaches would improve the effectiveness and inclusiveness of extension services across the project landscape.

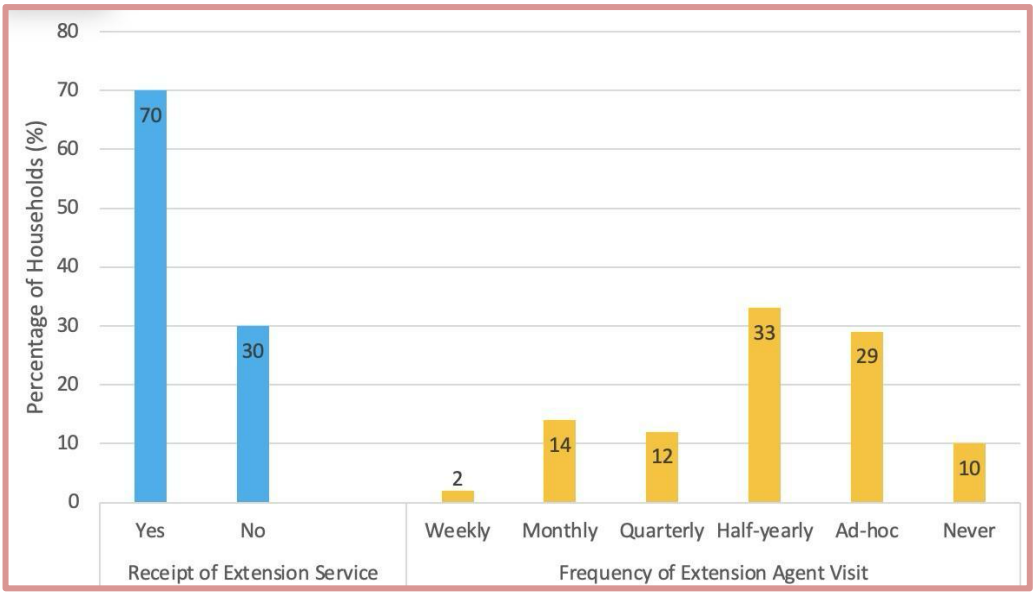


Figure 6.32: Receiving Extension Services and Frequency of Visits
(Source: Baseline HH Survey, 2026)

Access to extension services and the frequency of extension visits varied considerably across the six project Dzongkhags (**Table 6.49**). Pemagatshel recorded the highest extension coverage (95%), followed by Mongar (84%) and Samdrup Jongkhar (81%), indicating relatively stronger institutional outreach. In contrast, coverage was substantially lower in Trashigang (58%), Trashiyangtse (55%), and particularly in Lhuentse (37%), suggesting more limited-service coverage in these areas.

The regularity of extension visits also differed across Dzongkhags. Samdrup Jongkhar reported the most regular engagement, with relatively high proportions of HH receiving monthly (27%) and quarterly (25%) visits. Mongar showed a balanced pattern of half-yearly (36%), ad-hoc (31%), and quarterly (16%) visit. Although Pemagatshel had the highest service coverage, two-thirds of households (66%) reported receiving support on an ad-hoc basis, indicating that high coverage does not necessarily translate into regular engagement.

In contrast, extension support was less frequent and more irregular in Lhuentse, Trashigang, and Trashiyangtse. In Lhuentse, more than half of HH (53%) received only half-yearly visits, while 22% reported never being visited. Trashigang was characterized mainly by ad-hoc (50%) and half-yearly (39%) visits, whereas Trashiyangtse recorded the highest proportion of HH that had never received an extension visit (29%), despite some HH receiving half-yearly (39%) and monthly (30%) visits.

Overall, the findings reveal substantial geographic disparities in both access to and continuity of extension services. While institutional outreach is relatively strong in Pemagatshel, Mongar, and Samdrup Jongkhar, improving the regularity and consistency of field engagement remains a priority across all Dzongkhags, particularly in Lhuentse, Trashigang, and Trashiyangtse, where both service coverage and continuity are comparatively limited.

Table 6.49: Access to extension services and frequency of visits by Dzongkhag (n = 412)

Dzongkhags	**Sample Size(n)**	**Access to Extension Service**		**Frequency of Extension Service Agent's Visit**					
		Yes (%)	**No (%)**	**Weekly (%)**	**Monthly (%)**	**Quarterly (%)**	**Half-Yearly (%)**	**Ad-hoc (%)**	**Never (%)**
Lhuentse	32	37	63	3	19	3	53	0	22
Mongar	45	84	16	0	18	16	36	31	0

Pemagatshel	61	95	5	0	0	26	5	66	3
Samdrup Jongkhar	95	81	19	3	27	25	33	2	9
Trashigang	123	58	42	3	0	0	39	50	7
Trashiyangtse	56	55	45	0	30	2	39	0	29

(Source: Baseline HH Survey, 2026)
***Note**: Percentages are calculated for each Dzongkhag sample*

6.11.3 Awareness and Satisfaction with Government Programs and Projects

The baseline findings indicate that awareness of government programs and projects supporting sustainable agriculture and livestock farming remains relatively limited across the project area. Of the 412 HH surveyed, 44% reported being aware of such programs, while the majority (56%) were unaware of any government initiatives (**Figure 6.33**). This suggests that a substantial proportion of farming households may not be accessing available support due to limited awareness.

Among the 183 HH that were aware of government programs and projects,74% expressed satisfaction with the support received, while 26% reported dissatisfaction (**Figure 6.33**). The high level of satisfaction suggests that existing interventions are generally perceived as beneficial by HH that have accessed them. This is consistent with FGD and KII findings, where participants highlighted the provision of seeds, fencing materials, crop netting, dairy cattle subsidies, and agricultural infrastructure as valuable contributions to improving farming and livestock production. However, the proportion of dissatisfied respondents indicates that the quality, consistency, and accessibility of support remain uneven across communities.

Overall, the finding indicate that the principal challenge lies less in the perceived effectiveness of government support than in ensuring that information on available programs reaches a wider segment of farming households. Strengthening information dissemination, community outreach, and coordination among extension services, local governments, and community-based organizations would improve awareness, participation, and equitable access to government support, particularly in remote and underserved areas.

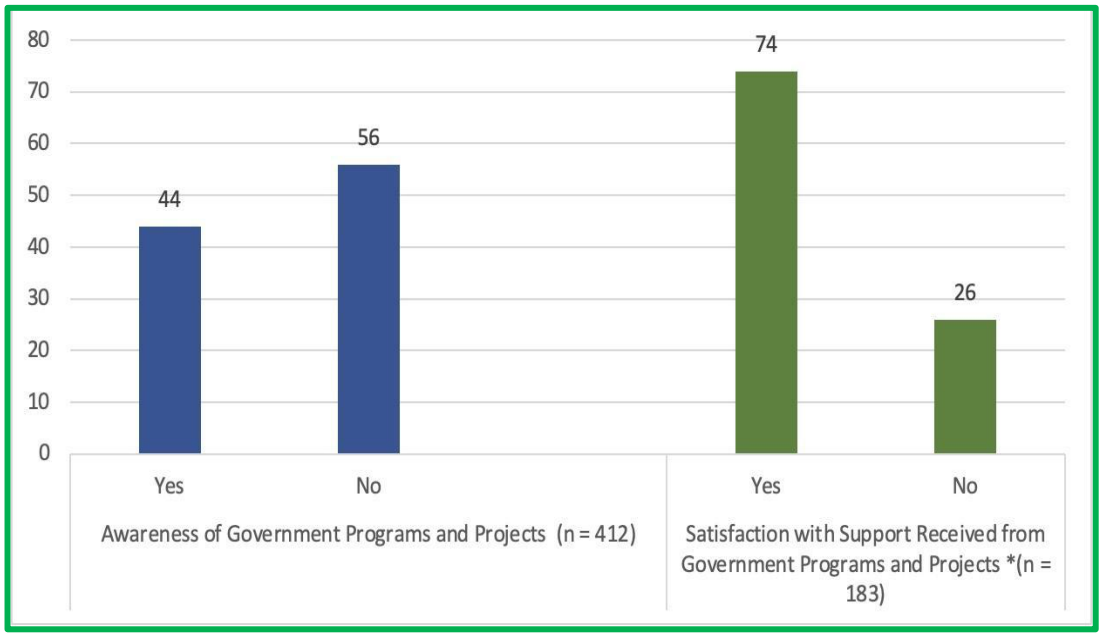


Figure 6.33: Awareness and Satisfaction with Government Programs and Projects
(Source: Baseline HH Survey, 2026)
***Note**: Percentages are calculated based only on HH that reported being aware of government programs and projects (n = 183). Therefore, the results represent the satisfaction among aware HH rather than among all surveyed HH.*

Awareness of government programs supporting varied considerably across the six project Dzongkhags (**Table 6.50).** Mongar recorded the highest level of awareness (71%), followed by Pemagatshel (57%) and Trashiyangtse (54%), suggesting relatively stronger outreach and information dissemination in these Dzongkhags. In contrast, awareness was lowest in Lhuentse (22%) and Samdrup Jongkhar (28%), while Trashigang recorded a moderate level of awareness (42%), indicating that many HH remain uninformed about available government support.

Among respondents who were aware of government programs, satisfaction with the support received was generally high across the project areas, although it varied by Dzongkhag (**Table 6.50**). Trashiyangtse recorded the highest satisfaction (90%), followed by Samdrup Jongkhar (85%) and Mongar (84%). Satisfaction was comparatively lower in Pemagatshel (66%) and Trashigang (62%), while Lhuentse recorded the lowest satisfaction (43%), with more than half of respondents (57%) expressing dissatisfaction.

The findings further indicate that awareness does not necessarily correspond with satisfaction. For example, Samdrup Jongkhar had relatively low awareness but high satisfaction among beneficiaries, whereas Lhuentse recorded both low awareness and the lowest satisfaction. These variations highlight the need to strengthen communication and outreach in areas with limited awareness while improving the consistency, accessibility, and responsiveness of government support in Dzongkhags where satisfaction remains comparatively low.

Table 6.50: Respondents' awareness of government programs and projects

Dzongkhag	Sample(n)	Awareness(n=412)		Sample(n)	Satisfaction(n=183[3])	
		Yes (%)	No (%)		Yes (%)	No (%)
Lhuentse	32	22	78	7	43	57
Mongar	45	71	29	32	84	16
Pemagatshel	61	57	43	35	66	34
Samdrup Jongkhar	95	28	72	27	85	15
Trashigang	123	42	58	52	62	38
Trashiyangtse	56	54	46	30	90	10

(Source: Baseline HH Survey, 2026)

6.11.4 Coordination Mechanism

The assessment of coordination mechanism was undertaken exclusively through KIIs with officials from central agencies, protected area management, and local governments, as the topic was considered institutional in nature and not appropriate for inclusion in the HH survey.

The qualitative findings indicated that coordination among relevant agencies exists but is largely informal, project-specific, and driven by operational needs rather than by an established institutional framework. Collaboration commonly occurs through direct communication between central agencies, Dzongkhag Administrations, Gewogs, extension officers, and technical institutions for activities such as agricultural extension, seed and fertilizer distribution, soil management, irrigation support, and selected livelihood initiatives. Local governments also reported using Gewog Tshogdey meetings and formal correspondence to facilitate inter-sectoral planning and coordination.

Despite these arrangements, most respondents highlighted the absence of a formal, structured coordination mechanism, particularly between the agriculture and conservation sectors. PA officials noted that collaboration is generally undertaken on an ad hoc basis, with agencies often implementing activities independently except where specific joint initiatives or data-sharing arrangements are required. Respondents

[3] *For "Satisfaction" percentages are also calculated based only on HH that reported being aware of government programs and projects (n = 183).*

emphasized that stronger institutional coordination would improve resource utilization, reduce duplication of efforts, and enhance support to local communities.

Central agencies similarly acknowledged that, although coordination mechanisms are in place, their effectiveness is constrained by weak communication and information sharing, inconsistent reporting, and limited follow-up and monitoring. Several respondents also highlighted operational challenges, including shortages of extension personnel, staff attrition, reliance on individual initiative, and declining opportunities for face-to-face coordination. These factors were reported to affect the timely delivery of technical services and inputs and reduce the overall effectiveness of inter-agency collaboration.

The findings clearly suggest that while collaboration among institutions is common, coordination remains fragmented and largely dependent on personal networks and project-specific arrangements. Strengthening formal coordination mechanisms, improving communication and reporting systems, clarifying institutional roles and responsibilities, and enhancing joint planning and monitoring would help improve service delivery and support more integrated implementation of project interventions.

6.12 Knowledge, Attitudes and Practices (KAP)

6.12.1 Knowledge and Attitude

Knowledge, attitudes, and practices (KAP) encompass a wide range of behavioural and institutional dimensions. This assessment, however, focused on a selected set of composite indicators that are most relevant to the project objectives, including awareness of sustainable agricultural practices, knowledge of climate-resilient farming, and perceptions of the benefits of sustainable agriculture.

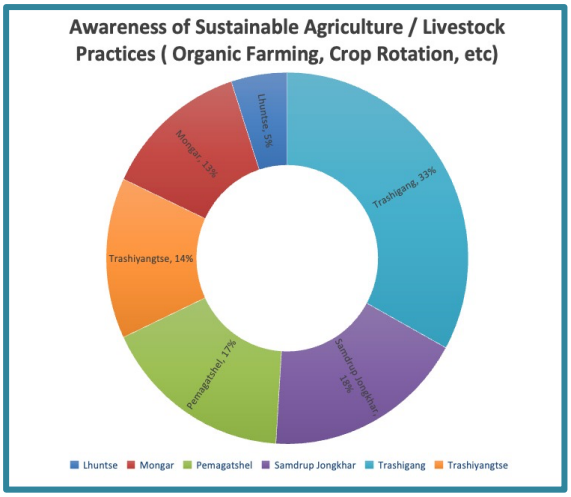
Overall, the findings indicate a favourable knowledge base and positive attitudes towards sustainable agriculture and climate resilience. 70% of HHs reported awareness of sustainable agricultural and livestock practices, while 65% demonstrated knowledge of climate-resilient farming approaches. An even larger proportion (83%) believed that sustainable farming practices improve agricultural productivity while protecting environmental health (**Table 6.51**). These findings suggest that willingness to adopt sustainable practices is generally high. However, the considerably lower adoption of several practices, together with limited participation in formal training programmes, indicates that the principal constraints lie in inadequate access to technical knowledge, extension support, quality inputs, and practical capacity-building rather than a lack of positive attitudes. Given the prominent role of women in farm decision-making and their comparatively limited access to education and extension services, strengthening gender-responsive extension systems and farmer-to-farmer learning platforms offers a strategic opportunity to accelerate the uptake of sustainable practices.

Table 6.51: Knowledge and attitudes on sustainable agricultural practices

Indicator	n	Yes(n)	Yes (%)
Aware of sustainable agriculture/ livestock practices	412	287	69.7
Know climate-resilient practices	412	269	65.3
Believe sustainable farming helps productivity and environmental health	412	343	83.3

(Source: Baseline HH Survey, 2026)

Marked spatial variation was observed across the project Dzongkhags (**Figure 6.34**). Trashigang consistently recorded the highest levels of awareness and positive perceptions, accounting for 33% of respondents aware of sustainable agricultural and livestock practices, 32% with knowledge of climate-resilient farming, and 34% expressing confidence in the benefits of sustainable agriculture. In contrast, Lhuentse recorded the lowest proportions across the three indicators, with 5%, 8%, and 7%, respectively. The remaining Dzongkhags exhibited broadly comparable levels of awareness and attitudes, with only moderate variation between them.



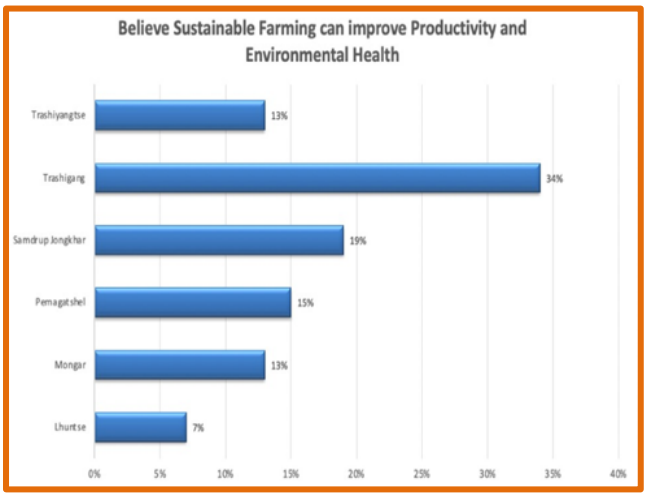


Figure 6.34: Variation in knowledge of climate-resilient practices across project Dzongkhags
(Source: Baseline HH Survey, 2026)

The Dzongkhags and Gewogs exhibiting comparatively lower levels of knowledge and aptitude for sustainable climate-resilient agricultural and livestock practices were largely consistent, as presented in the table below (**Table 6.52**).

Table 6.52: Gewogs with lower knowledge and attitudes on sustainable agricultural practices

S.no	Dzongkhags	Gewogs	Remarks
1	Lhuentse	Tsaenkhar, Minjey	Training priorities Gewogs
2	Mongar	Drepong, Silambi	
3	Pemagatshel	Decheling, Nanong	
4	Samdrup Jongkhar	Langchenphu, Lauri, Martshala, Gomdar	
5	Trashigang	Merak, Sakteng, Yangneer	
6	Trashiyangtse	Bumdeling, Ramjar, Khamdang	

(Source: Baseline HH Survey, 2026)

Qualitative findings from the FGD indicate that although awareness of sustainable agriculture is increasing, the adoption of practices such as crop rotation, integrated land management, and other sustainable farming approaches remains uneven across communities. Limited access to extension services, technical guidance, quality inputs, and labour continues to constrain the translation of knowledge into practice.

Nevertheless, respondents demonstrated a sound understanding of climate-resilient agriculture, identifying crop diversification, efficient water management, climate-resilient crop varieties, organic farming, and sustainable land management as key adaptation strategies. Farmers also expressed strong confidence that these practices improve soil fertility, conserve natural resources, strengthen resilience to climate change, and enhance long-term agricultural productivity, environmental sustainability, and rural livelihoods.

6.12.2 Current Practices and Adoption Barriers

Among the seven sustainable agricultural practices assessed, the application of organic manure was by far the most widely adopted practice (92%), followed by crop rotation (75%), soil and water conservation measures (67%), and stall feeding or improved manure management (57%) (**Figure 6.35**). In contrast, adoption of integrated pest and disease management remained comparatively low (30%), while agroforestry (44%) and pasture improvement (41%) also recorded modest uptake.

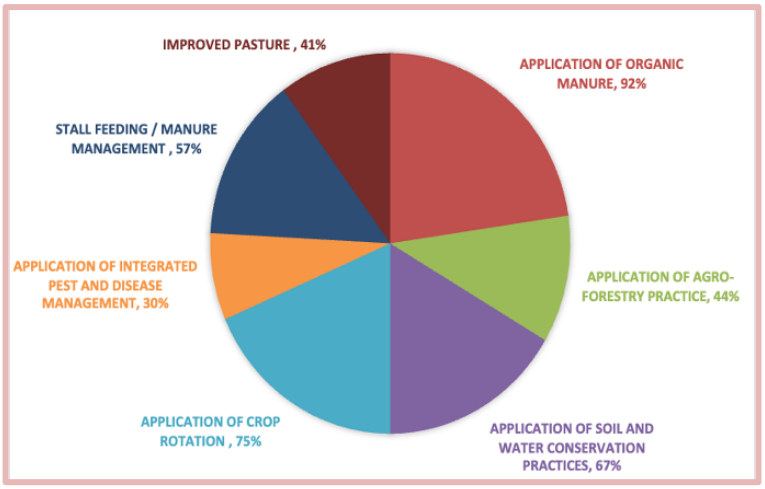


Figure 6.35: Types of sustainable agricultural practices
(Source: Baseline HH survey, 2026)

Dzongkhag-level analysis reveals considerable variation in the adoption of these practices. Organic manure application was most prevalent in Trashigang (28%), followed by Samdrup Jongkhar (24%) and Pemagatshel (15%), whereas Lhuentse recorded the lowest adoption (8%). Agroforestry was also most widely practiced in Trashigang (31%), followed by Pemagatshel (18%), with Samdrup Jongkhar and Trashiyangtse each accounting for 16%, while Lhuentse again recorded the lowest uptake (7%) (**Figure 6.36**).

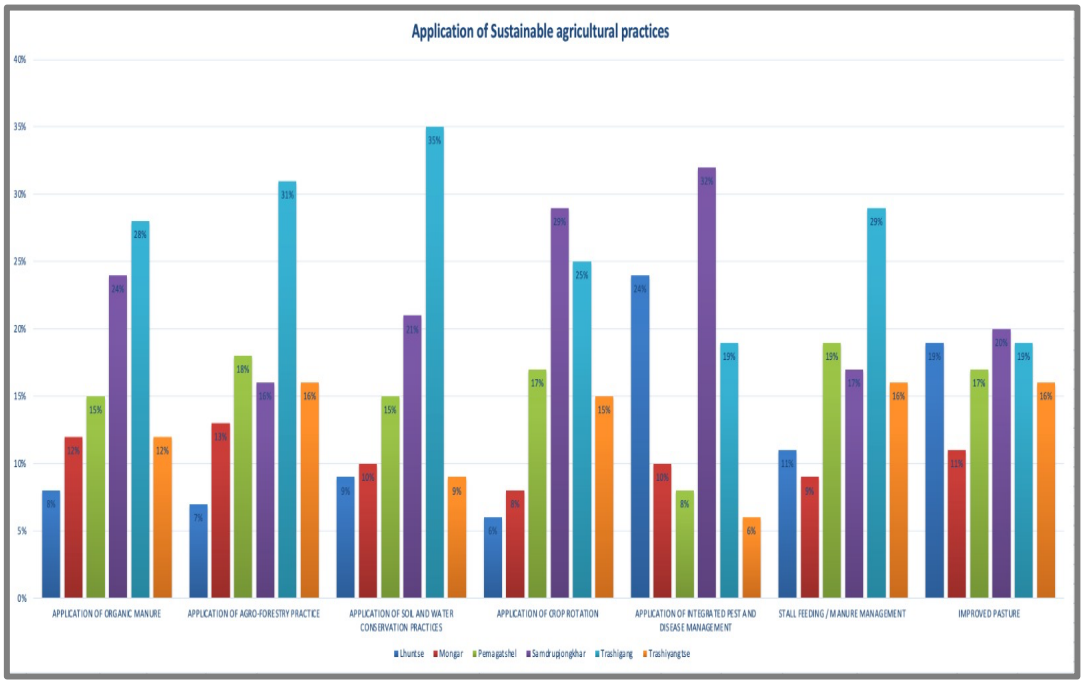


Figure 6.36: Spatial variation of sustainable agricultural practices across Dzongkhags
(Source: Baseline HH Survey, 2026)

The adoption of soil and water conservation practices was highest in Trashigang (35%), followed by Samdrup Jongkhar (21%) and Pemagatshel (15%), whereas Lhuentse and Trashiyangtse each accounted for only 9%. Crop rotation was most common in Samdrup Jongkhar (29%), followed by Trashigang (25%) and Pemagatshel (21%), with Lhuentse reporting the lowest adoption (6%) (**Figure 6.36**).

Integrated pest and disease management was most frequently practiced in Samdrup Jongkhar (32%), followed by Lhuentse (24%) and Trashigang (19%), while adoption was lowest in Trashiyangtse (6%). Stall feeding and manure management showed relatively consistent adoption across Dzongkhags, although Trashigang recorded the highest proportion of adopters (29%) and Mongar the lowest (9%). Similarly, pasture improvement practices exhibited limited inter-Dzongkhag variation, ranging from 11% in Mongar to 20% in Samdrup Jongkhar (**Figure 6.36**).

Among the five key barriers identified, lack of knowledge and technical training emerged as the most significant constraint to the adoption of sustainable agricultural practices, cited by 48% of respondents. This was followed by high costs of adoption (18%), limited access to agricultural and livestock inputs (16%), and labour shortages (11%), while only 7% identified inadequate government support or incentives as a major impediment, suggesting that existing public support mechanisms are generally accessible (**Figure 6.37**).

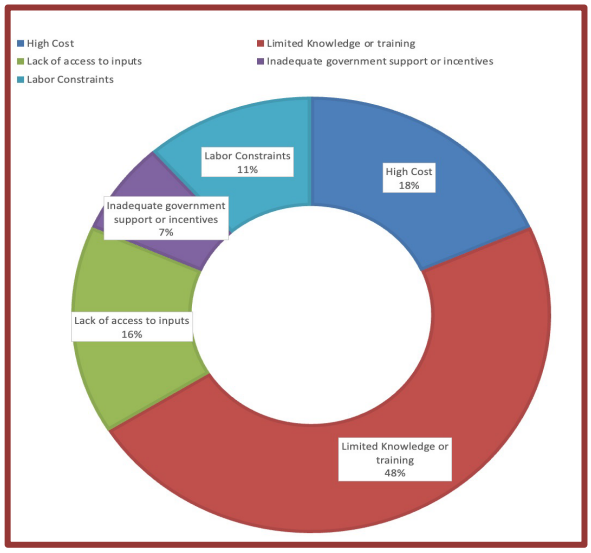


Figure 6.37: Key barriers to adoption of sustainable agriculture and livestock practices
(Source: Baseline HH Survey, 2026)

Dzongkhag-level analysis reveals notable variations in perceived constraints. Farmers in Trashigang and Samdrup Jongkhar most frequently identified inadequate knowledge and training as the principal barrier, whereas this concern was comparatively less pronounced in Mongar and Lhuentse. Perceptions of high adoption costs were strongest in Trashigang (31%) and Pemagatshel (29%), while respondents from Lhuentse (4%) and Samdrup Jongkhar (7%) considered cost to be a relatively minor obstacle (**Figure 6.38)**.

Limited access to agricultural and livestock inputs was identified as a major challenge in Trashigang (35%) and Samdrup Jongkhar (29%), contrasting with Trashiyangtse (5%) and Lhuentse (1%), where this issue was reported far less frequently. Although inadequate government support received the lowest overall rating, it was more prominently perceived in Samdrup Jongkhar (49%) and Pemagatshel (21%) (**Figure 6.38)**. Labour shortages, meanwhile, were most acute in Trashigang (32%), followed by Mongar (24%) and Trashiyangtse (20%).

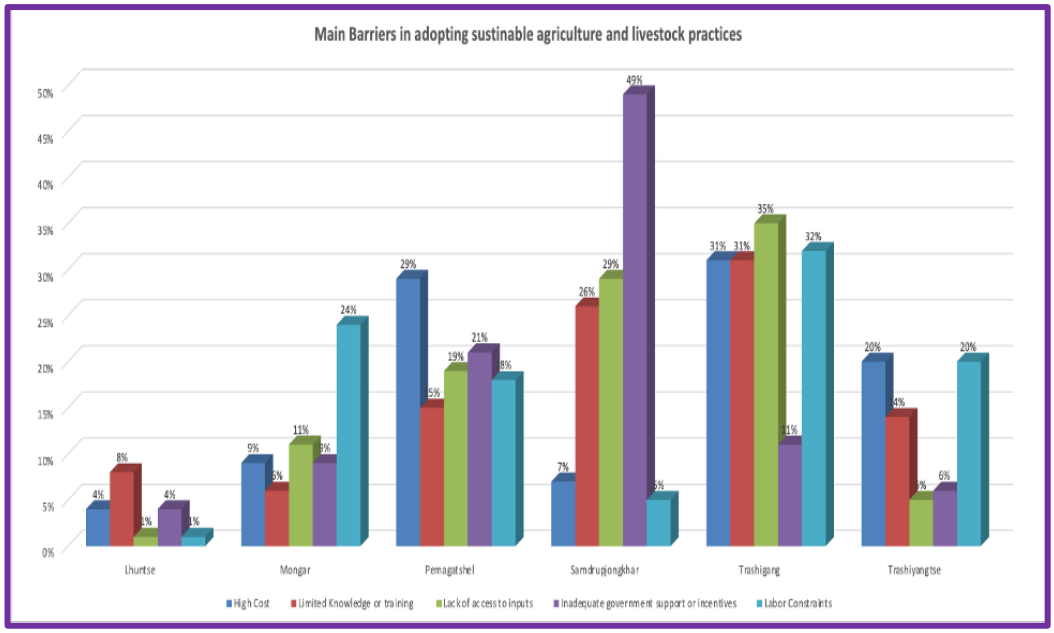


Figure 6.38: Spatial variation in key barriers to the adoption of sustainable agricultural practices
(Source: Baseline HH Survey, 2026)

The qualitative assessment reinforces these findings, indicating that the adoption of sustainable agricultural practices is constrained not only by limited technical knowledge and extension services but also by labour shortages, water scarcity, inadequate irrigation infrastructure, weak market incentives, and insufficient follow-up support, all of which hinder the effective translation of knowledge into sustained on-farm practice.

6.13 Environmental and Social Safeguards and Risks

This section assesses the baseline status of environmental and social safeguards and associated risks across the six project Dzongkhag to establish the existing conditions for avoiding, minimizing, and mitigating potential adverse environmental and social impacts arising from agriculture and livestock development interventions. The analysis focuses on four key indicators: environmental context, stakeholder engagement and consultation, inclusive consultation and grievance mechanism.

6.13.1 Environmental Context: Presence of Environmental Sensitive Areas Near Farmland

The baseline findings indicate that most farming HHs are located close to environmentally sensitive areas (**Figure 6.39**). Forests were by far the most frequently reported feature, with 92% of HH indicating that their farmland is adjacent to or near forested areas. This reflects the strong forest–agriculture interface that characterizes much of the project landscape and has important implications for biodiversity conservation, natural resource management, and human–wildlife interactions. Consistent with national studies, the close proximity of agricultural land to forests contributes to increased human–wildlife conflict, which remains one of the major constraints to agricultural production and rural livelihoods in Bhutan (MoAL, n.d.; Shangshon et al., 2023). Key informants from PA management further noted that increasing wildlife populations resulting from improved conservation management have contributed to more frequent human–wildlife interactions in some project areas, particularly involving wild pigs, bears, wild dogs, and large carnivores.

More than one-quarter of HH (26%) reported wildlife habitats near their farmland, while 12% identified protected areas. These findings suggest that a considerable proportion of project communities operate within or adjacent to ecologically important landscapes where conservation and livelihood objectives need to be carefully balanced. Although key informants acknowledged that conservation initiatives have strengthened biodiversity protection, they also noted that local communities often associate these efforts with increased crop and livestock losses from wildlife. At the same time, park officials reported that collaboration and mutual understanding between protected area management and local communities have improved over time. Key Biodiversity Areas (0%), Potential Groundwater Recharge Areas (0%), Payment for Ecosystem Areas (0%)

and Conservation Around Buffer Zone and Heritage Sites (0%) were reported by virtually negligible or no respondents, which may reflect their limited presence within the surveyed areas, limited respondent awareness, or both.

The findings clearly demonstrate that agricultural livelihoods across the project landscape are closely linked with ecologically sensitive environments. Both the survey and qualitative findings underscore the need for sustainable land management practices that balance agricultural production with biodiversity conservation while strengthening measures to mitigate human–wildlife conflict and promote coexistence between farming and wildlife conservation.

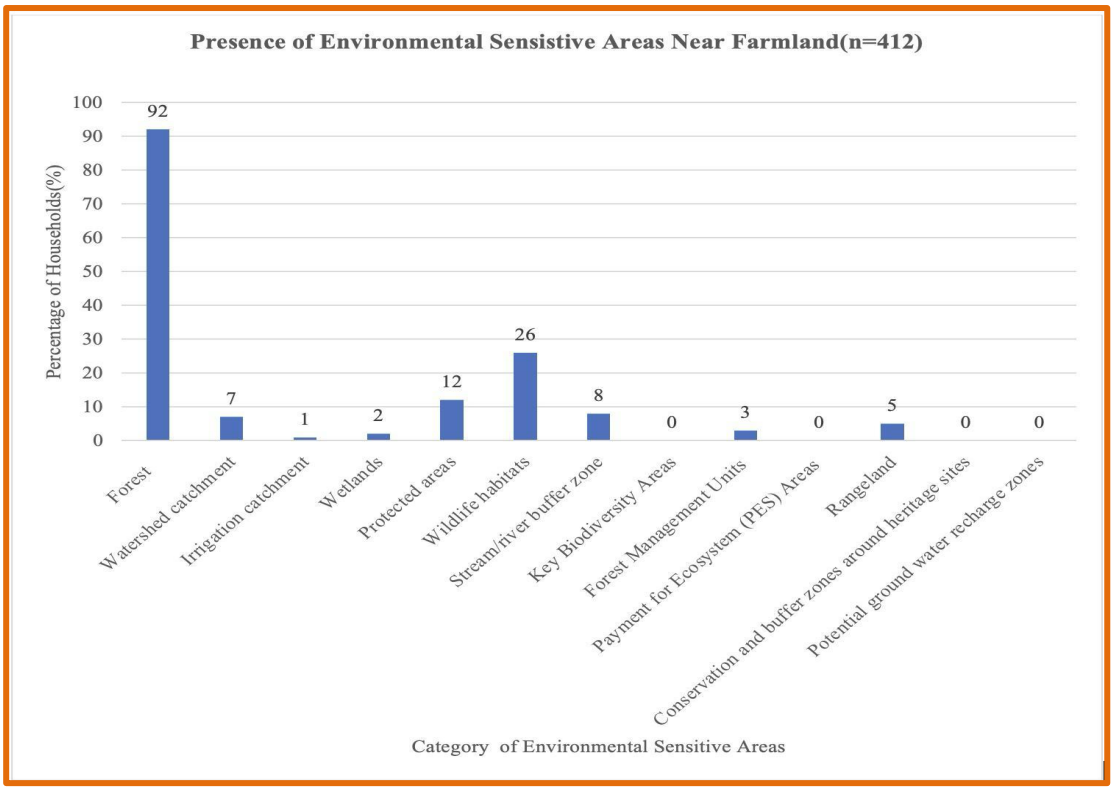


Figure 6.39: Environmentally sensitive areas near farmland
(Source: Baseline HH Survey, 2026)

Note: *Percentages exceed 100% because respondents could identify more than one environmentally sensitive areas near their farmland (multiple responses).*

The distribution of environmentally sensitive areas near farmland varied across the six project Dzongkhags (**Table 6.53**). Forests were the dominant in every Dzongkhag, reported by 82% – 97% of HH, confirming the close association between farming systems and forest ecosystems throughout the project landscape.

Wildlife habitats were reported most frequently in Trashiyangtse (41%), Mongar (36%), Samdrup Jongkhar (34%), and Pemagatshel (33%), suggesting comparatively greater potential for human–wildlife interactions in these Dzongkhags. Protected areas were most commonly reported in Samdrup Jongkhar (27%) and Trashiyangtse (20%), indicating that a sizable proportion of farming HH operate in or adjacent to conservation landscapes.

Water-related environmentally sensitive areas also showed spatial variation. Stream or river buffer zones were most common in Pemagatshel (26%), while watershed catchments in Mongar (18%) and Samdrup Jongkhar (11%) and wetlands (14%) together with and irrigation catchments (9%) were reported mainly in Trashiyangtse, reflecting the presence of locally important water resources. Rangelands and Forest Management Units were reported most frequently in Trashigang (11% and 9%, respectively), followed by Trashiyangtse (7% and 4%, respectively), reflecting localized environmental characteristics.

Overall, the findings highlight important spatial differences in the environmental context of agricultural production across the project Dzongkhags. These variations should be considered in designing location-specific interventions for biodiversity conservation, watershed management, climate resilience, and human–wildlife conflict mitigation.

Table 6.53: Environmentally sensitive areas near farmland(n=412)

Dzongkhag	FR (%)	WH (%)	PA (%)	SRBZ (%)	WC (%)	RL (%)	FMU (%)	WL (%)	IC (%)	KBA (%)	PGWR (%)
Lhuentse (32)	97	0	6	0	0	3	0	0	0	0	0
Mongar (45)	89	36	0	0	18	2	0	0	2	0	0
Pemagatshel (61)	97	33	0	26	3	0	2	0	0	0	0
Samdrup Jongkhar (95)	94	34	27	5	11	2	0	0	0	1	0
Trashigang (123)	92	13	10	10	6	11	9	0	0	0	1
Trashiyangtse (56)	82	41	20	2	2	7	4	14	9	0	0

(Source: Baseline HH Survey, 2026)
Abbreviations: *FR=Forest; WH=Wildlife Habitat; PA=Protected Area; SRBZ=Stream/River Buffer Zone; WC=Watershed Catchment; RL= Rangeland; FMU=Forest Management Unit; WL=Wetland/Ramsar Site; IC=Irrigation Catchment; KBA=Key Biodiversity Area; PGWR=Potential Groundwater Recharge Area.*
Note: *percentages exceed 100% because respondents could identify more than one environmentally sensitive area near their farmland.*

6.13.2 Perceived Negative Environmental Impacts and HH Affected by Development Project

The baseline findings indicate that 29% of HH perceived negative environmental impacts associated with development projects, while 17% reported that their HH had been directly affected by such projects (**Figure 6.40**). Although most respondents did not perceive adverse environmental impacts (71%) or report direct HH impacts (83%), the findings suggest environmental and social concerns persist in some project communities and should be considered during project planning and implementation.

FGD and KII findings provide important context for these perceptions. Human-wildlife conflict (HWC) emerged as the frequently cited environmental concern across the project landscape. While respondents generally did not attribute HWC directly to development projects, they identified it as a persistent challenge affecting agricultural production and rural livelihoods in forest–agriculture landscapes. Communities in Serthi, for example, reported that HWC reported continuing crop losses from wildlife, while officials from Sakteng and Jomotshangkha Wildlife Sanctuaries noted that increasing wildlife populations have contributed to more frequent crop damage and livestock predation. These observations are consistent with national studies identifying HWC as a major environmental and livelihood challenge in Bhutan (Sangay et al., 2008; Wangchuk et al., 2023; MoAL, n.d.; MoAL, 2023).

At the same time, qualitative findings demonstrate that development interventions can generate positive environmental and livelihood outcomes when accompanied by effective safeguards and institutional support. Respondents highlighted that electric and chain-link fencing, HWC mitigation measures, improved seeds, crop netting, livestock support, and dairy infrastructure have strengthened agricultural production while reducing wildlife-related losses in several communities. Conversely, delayed delivery or undelivered agricultural inputs, inadequate technical follow-up, and limited institutional support, were identified as factors that reduced the effectiveness of project interventions. These findings are consistent with previous studies showing that development outcomes depend not only on project investment but also on sustained extension services, timely delivery of inputs and effective institutional support (Wangmo et al., 2021b; Kuenga & Gurung, 2022).

The project has incorporated an Environmental and Social Management Plan (ESMP), together with environmental and social safeguards, a Stakeholder Engagement Plan, and a Grievance Redress Mechanism to

identify, mitigate, and monitor potential environmental and social risks while promoting inclusive participation and accountability (FSIP PRODOC, 2025).

The findings suggest that perceived environmental impacts and HH impacts are relatively localized rather than widespread and are influenced by the effectiveness of project implementation and associated safeguard measures. This reinforces the importance of integrated landscape approaches that combine sustainable land management, biodiversity conservation, community-based HWC mitigation, meaningful stakeholder engagement, and responsive institutional support to maximize project benefits while minimizing environmental and social risks (MoAL & FAO, 2025; IPBES, 2019).

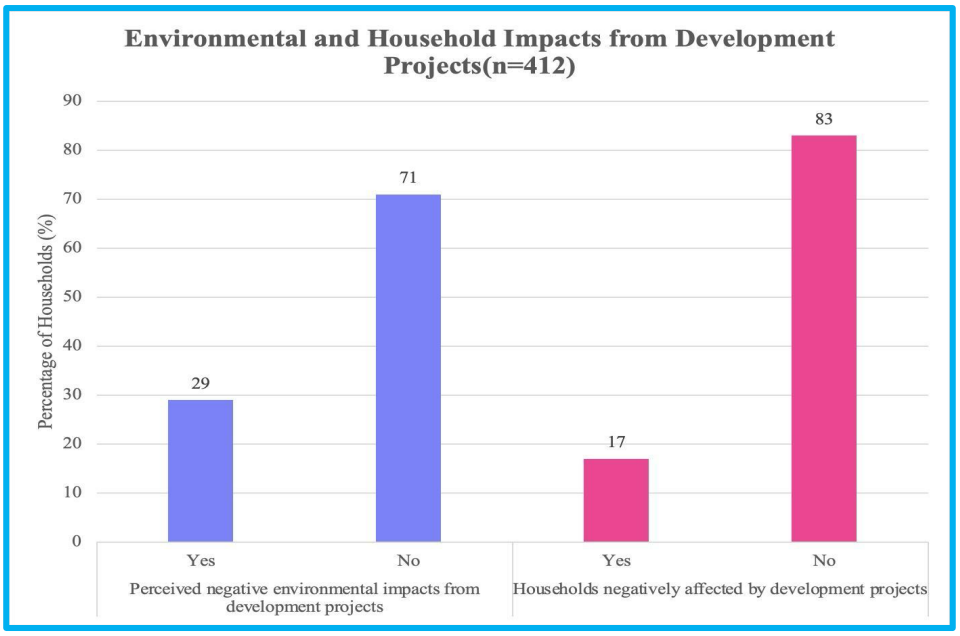


Figure 6.40: Environmental impacts and being negatively impacted by development activities
(Source: Baseline HH Survey, 2026)

Variation was evident across the six project Dzongkhags in both perceived environmental impacts and HH reporting direct negative impacts from development projects (**Table 6.54**). Lhuentse recorded the highest proportion of HH perceiving negative environmental impacts (50%), followed by Trashiyangtse (46%), while Pemagatshel and Trashigang each reported 28%. The lowest proportion were observed in Samdrup Jongkhar (18%) and Mongar (16%).

A similar pattern was observed for HH reporting direct negative impacts. Lhuentse and Trashiyangtse again reported the highest proportions of affected HH (37% each), followed by Trashigang (17%). In contrast, relatively few HH reported direct impacts in Pemagatshel (9%)**,** Mongar (6%), and Samdrup Jongkhar (3%)**.**

The broadly similar distribution of perceived environmental impacts and reported HH impacts across Dzongkhags suggests that areas where environmental concerns are more prominent also tend to report a higher incidence of direct HH impacts. The findings highlight the need for monitoring and stakeholder engagement, particularly in Lhuentse and Trashiyangtse, where perceived and reported impacts are comparatively higher.

Table 6.54: Perceived negative environmental impacts and HHs affected by project activities

Dzongkhag	Sample(n)	Perceived Environmental Impacts		Affected HH	
		Yes (%)	No (%)	Yes (%)	No (%)
Lhuentse	32	50	50	37	63
Mongar	45	16	84	6	94
Pemagatshel	61	28	72	9	91

Samdrup Jongkhar	95	18	82	3	97
Trashigang	123	28	72	17	83
Trashiyangtse	56	46	54	37	63

(Source: Baseline HH Survey, 2026)
Note: *Percentages are calculated using the total number of respondents within each Dzongkhag.*

6.13.3 Stakeholder Engagement and Consultation

The baseline findings indicate relatively limited community engagement during project design and even lower inclusion of vulnerable HH in consultation processes. Less than half of the surveyed HH (48%) reported that community consultations were conducted during project design, while 52% indicated that no such consultations had taken place (**Figure 6.41**). Similarly, only 44% reported that vulnerable HH participated in community consultations, compared with 56% who indicated that they were not involved. These findings suggest that, even where consultations occurred, the participation of marginalized and vulnerable groups was not consistently ensured.

These survey findings are consistent with the literature, which emphasizes that meaningful community participation and inclusive planning are fundamental to effective and sustainable development interventions (Wangmo et al., 2021a; Dorji & Gurung, 2022a). However, studies also notes that consultation alone does not guarantee meaningful participation unless women, poor households, persons with disabilities, older persons, and other vulnerable groups are actively engaged throughout planning and decision-making (Wangmo et al., 2021b; Shangshon et al., 2023). Farmer Groups, cooperatives, community organizations and extension services are recognized as important platforms for stakeholder engagement, although their effectiveness depends on institutional capacity, active leadership, and sustained community ownership (Choden et al., 2022; Moktan et al., 2008; Rigyal & Wongsamun, 2011).

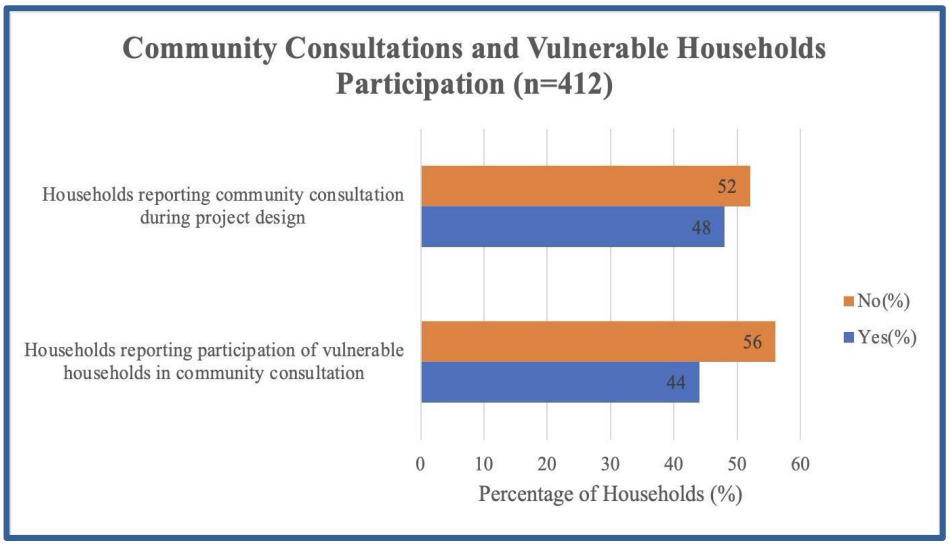


Figure 6.41: Community consultation and vulnerable HH's participation during project design
(Source: Baseline HH Survey, 2026)

FGD and KII reinforce these observations, revealing considerable variation in stakeholder engagement across the project landscape. Communities with stronger local institutions and active farmer, women, and youth groups generally reported more inclusive consultation processes and greater participation of vulnerable households. In contrast, communities with weak or inactive organizations, limited extension support, and fragmented service delivery experienced lower levels of consultation and fewer opportunities for vulnerable groups to participate meaningfully. Respondents also noted that consultations were, in some cases, largely procedural and had limited influence on project planning and implementation. Conversely, successful community institutions, such as the Yangneer Cooperative, demonstrated how well-functioning local organizations can strengthen inclusive participation and community ownership.

To address these baseline gaps, the project has developed a Stakeholder Engagement Plan (SEP) that promotes inclusive participation throughout implementation through stakeholder mapping, targeted engagement of vulnerable groups, accessible consultation processes, a functional Grievance Redress Mechanism (GRM), and institutional strengthening of community organizations(FSIP PRODOC, 2025).These measures are intended to enhance the quality of stakeholder engagement, strengthen local ownership, and improve the responsiveness of project interventions.

The baseline findings eventually suggest that stakeholder engagement during project design remains inconsistent across the project landscape, with inclusiveness requiring further strengthening. Improving the quality and inclusiveness of consultations, reinforcing local institutions, enhancing extension facilitation, and ensuring the systematic participation of women, poor HH, persons with disabilities, elderly people, and other vulnerable groups will be critical for improving transparency, local ownership, social equity, and the long-term sustainability of project interventions.

Table 6.55: Community consultation and participation of vulnerable HHs during project design

Dzongkhag	**Sample (n)**	**Community Consultation during Project Design**		**Participation of vulnerable HH in community consultation**	
		Yes (%)	**No (%)**	**Yes (%)**	**No (%)**
Lhuentse	32	69	31	72	28
Mongar	45	40	60	42	58
Pemagatshel	61	25	75	43	57
Samdrup Jongkhar	95	25	75	13	58
Trashigang	123	74	26	75	25
Trashiyangtse	56	52	48	20	80

(Source: Baseline HH Survey, 2026)
Note: *Percentages are calculated using the total number of sampled HH within each Dzongkhag.*

The findings also reveal substantial variation across the six project Dzongkhags in both community consultation and the participation of vulnerable HH during project design, reflecting differences in the extent and inclusiveness of stakeholder engagement (**Table 6.55**). Trashigang recorded the highest levels of stakeholder engagement, with 74% of HH reporting that community consultation was conducted during project design and 75% indicating that vulnerable HH participated. Lhuentse also demonstrated relatively high levels of consultation (69%) and vulnerable HH participation (72%), suggesting comparatively stronger community engagement.

In contrast, Trashiyangtse exhibited a notable disparity between community consultation (52%) and vulnerable HH participation (20%), indicating that consultations were less inclusive of marginalized groups. Mongar recorded moderate levels of stakeholder engagement, with 40% of HH reporting community consultation and 42% reporting participation of vulnerable HH.

The lowest levels of community consultation were observed in Pemagatshel and Samdrup Jongkhar**,** where only one-quarter (25%) of HH reported consultation during project design. Vulnerable HH participation was particularly limited in Samdrup Jongkhar (13%), the lowest among all Dzongkhags, indicating comparatively weaker inclusion of vulnerable groups in project planning.

The baseline findings sufficiently demonstrate considerable spatial variation in both the extent and inclusiveness of stakeholder engagement across the project Dzongkhags. While community consultation was relatively stronger in Trashigang and Lhuentse, lower levels of engagement and inclusion were evident in Pemagatshel, Samdrup Jongkhar, and, to a lesser extent, Mongar and Trashiyangtse. These findings highlight the need to strengthen inclusive consultation processes and ensure the meaningful participation of vulnerable households throughout project implementation.

6.13.4 Awareness, Types, and Use of Grievance Redress Mechanisms

While stakeholder consultation promotes community participation during project planning, effective grievance redress mechanism (GRMs) enables communities to raise concerns and seek resolution throughout project implementation. Together, these processes strengthen transparency, accountability, and inclusive project governance.

The baseline findings indicate that while GRMs exist in some form, across the project landscape awareness remains limited and usage is even lower, indicating significant gaps in accessibility, and effectiveness. As shown in **Figure 6.42**, only 40% of HH were aware of grievance mechanisms, while 60% reported no awareness. Among those aware, the most commonly reported grievance channels were Gewog Administration (70%) and community leaders (68%), followed by community grievances committees (13%), suggestion boxes (8%), and hotlines (3%). This pattern reflects continued reliance on local government institutions and community leaders to address grievances, while more formal mechanisms remain limited or poorly known. Despite 40% of HH reporting awareness of grievance mechanisms, only 21% reported having used them, indicating that awareness alone does not necessarily translate into utilization.

The findings are consistent with the literature, which emphasizes that the effectiveness of local grievance system depends not only on their existence but also on effective communication, community engagement, institutional outreach, and public trust (Wangmo et al., 2021a; Wangmo et al., 2021b). Weak governance, limited outreach, inadequate institutional capacity, and poor access to information can reduce both the visibility and functionality of formal grievance systems, particularly structured channels such as hotlines and suggestion boxes (Shangshon et al., 2023; Kuenga & Gurung, 2022; Wangmo et al., 2021b).

FGD and KII findings reinforce these results. Participants in Jurmed (Mongar) described institutional platforms as a relatively new concept and not well understood, while responses in Khaling (Trashigang) reported declining communication with government agencies and fewer field visits by extension personnel. Farmers in Serthi (Samdrup Jongkhar) and Narang (Mongar) also cited repeated difficulties in obtaining requested agricultural support despite following up with authorities. These experiences suggest that limited institutional outreach and weak responsiveness may reduce community confidence in formal grievance systems, discouraging HH from reporting concerns even when mechanisms exist.

To address these baseline gaps, the project has established a comprehensive project-level GRM under the Environmental and Social Management Plan (ESMP) and Stakeholder Engagement Plan (SEP). The GRM provides a structured, multi-tier grievance process at the Gewog, Dzongkhag, and Project levels, with escalation to the FAO Representation and higher levels where required (FSIP PRODOC, 2025). It includes designated grievance focal persons, defined response timelines, clear procedures for grievance registration, investigation, resolution, monitoring, and reporting, and dedicated provisions for disclosure, awareness raising, capacity building, confidentiality, and the handling of grievances related to vulnerable groups, gender-based violence, sexual exploitation and abuse, and project workers (FSIP PRODOC, 2025).

The findings consistently indicate that low awareness and limited usage of grievance mechanisms stem from broader challenges in institutional communication, accessibility, and public confidence. Effective implementation of the project GRM, together with sustained community awareness, institutional responsiveness, and regular monitoring, will be essential for strengthening accountability and ensuring that grievances are addressed in a timely, transparent, and inclusive manner.

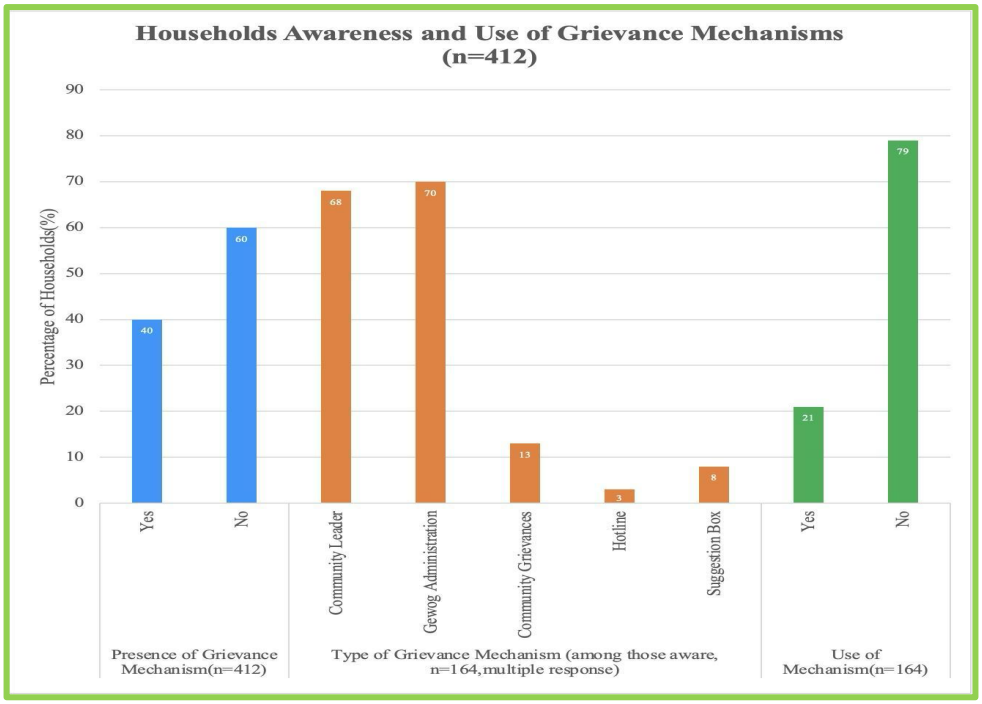


Figure 6.42: Awareness and use of grievance redress mechanism
(Source: Baseline HH Survey, 2026)

***Note**: Percentage calculated for the type and use of GRM on HHs who responded "Yes" to the awareness of GRM.*

Awareness of GRM was generally low across six project Dzongkhags (**Table 6.56**). In every Dzongkhag, fewer than half of the surveyed HH reported being aware of a GRM, suggesting limited awareness of formal mechanisms for raising and resolving community concerns. Among the six Dzongkhags, Trashigang recorded the highest level of awareness (49%), followed by Samdrup Jongkhar (39%). Mongar and Pemagatshel each reported 36% awareness, while Lhuentse (34%) and Trashiyangtse (32%) recorded the lowest levels. Despite these differences, the majority of HH in every Dzongkhag remained unaware of available grievance mechanisms.

Among HH that were aware of grievance mechanisms, the types of available grievance channels varied across the project area (**Table 6.57**). Gewog Administrations (70%) and community leaders (68%) were the predominant grievance channels in all Dzongkhags, highlighting their central role in local grievance resolution. In contrast, more formal mechanisms, including community grievance committee (13%), hotlines (3%), and suggestion boxes (8%), were reported far less frequently and were limited to only a few Dzongkhags. Community grievance committees and hotline services were reported mainly in Samdrup Jongkhar, while suggestion boxes were reported primarily in Lhuentse.

Utilization of available GRM was generally low across the project Dzongkhags (**Table 6.58**). Most households that were aware of GRMs reported never having used them, indicating that awareness does not necessarily result in use. Utilization was highest in Lhuentse (55%), followed by Samdrup Jongkhar (41%), Trashiyangtse (33%), and Mongar (25%), whereas it remained particularly low in Pemagatshel (5%) and Trashigang (3%).

The findings clearly reveal that both awareness and utilization of grievance redress mechanisms remain limited across the project landscape. While local Gewog Administration and community leaders continue to serve as the primary grievance channels, more formal grievance mechanisms remain poorly recognized and underutilized. Strengthening community awareness, institutional outreach, and confidence in grievance processes will be critical for improving the accessibility and effectiveness of grievance redress during project implementation.

Table 6.56: Presence of grievance redressal mechanism (n=412)

Dzongkhag	Sample (n)	Yes (%)	No (%)
Lhuentse	32	34	66
Mongar	45	36	64
Pemagatshel	61	36	64
Samdrup Jongkhar	95	39	61
Trashigang	123	49	51
Trashiyangtse	56	32	68
Total	**412**		

(Source: Baseline HH Survey, 2026)
Note: *Percentages are calculated using the total number of sampled HHs within each Dzongkhag.*

Table 6.57: Types of grievance redressal mechanism (n=412)

Dzongkhag	Sample(n)	Community Leader (%)	Gewog Administration (%)	Community Grievances (%)	Hotline (%)	Suggestion Box (%)
Lhuentse	11	9	18	0	0	91
Mongar	16	88	88	6	0	19
Pemagatshel	22	95	41	0	0	0
Samdrup Jongkhar	37	89	43	57	14	0
Trashigang	60	57	93	0	0	0
Trashiyangtse	18	44	100	0	0	0
Total	**412**					

(Source: Baseline HH Survey, 2026)
Note*: Multiple responses were allowed; therefore, percentages do not add up to 100%.*

Table 6.58: Use of available grievance redressal mechanism (n=164)

Dzongkhag	Sample(n)	Yes (%)	No (%)
Lhuentse	11	55	45
Mongar	16	25	75
Pemagatshel	22	5	95
Samdrup Jongkhar	37	41	59
Trashigang	60	3	67
Trashiyangtse	18	33	68
Total	**164**		

(Source: Baseline HH Survey, 2026)
Note: *Percentages are calculated based only on HH that reported being aware of the presence of grievance redress mechanisms (n = 164) for Table 6.49 &6.50. Therefore, the results represent the utilization of GRMs among aware HH rather than among all surveyed HH*

6.13.5 Human-Wildlife Conflict (HWC): Occurrence, Frequency and Severity

The baseline findings indicate that human-wildlife conflict (HWC) remains a significant challenge across the project landscape (**Figure 6.43**). Of the 412 HH surveyed, 63% (261 HH) reported experiencing at least one

HWC incident during the past three years, while 37% reported no such experiences. This high prevalence highlights the continued threat that wildlife poses to rural livelihoods, particularly for communities located near forests, wildlife habitats, and agricultural landscapes.

Among affected HH, HWC was generally recurrent rather than isolated. Nearly one-third (30%) reported that HWC occurred regularly, while 29% experienced incidents two to three times, 21% experienced more than six incidents, and 17% reported four to six incidents during the past three years. Only 4% experienced a single incident, indicating that wildlife-related damages are persistent for most affected HH.

The perceived severity of HWC further underscores its significance. Most affected HH (62%) rated the impact as moderate, while 15% considered them high and 23% low. Overall, more than three-quarters (77%) perceived HWC to have moderate to high impacts, reflecting its continued effects on agricultural production, HH income, food security, and overall well-being.

These findings are consistent with the literature, which identifies HWC as a persistent challenge in eastern Bhutan, were agricultural land interfaces with forest ecosystems. Wild boar, deer, monkeys, bears, and other wildlife frequently damage crops and livestock, with habitat overlap, landscape connectivity, and changing land-use patterns contributing to increased conflict (Sangay et al., 2008; Wangchuk et al., 2023). National studies further indicate that HWC results in annual crop losses ranging from 19% to 43%, highlighting the significant implications of HWC for household food security and farm incomes (MoAL, n.d.; MoAL, 2023).The literature also emphasizes that HWC represents a critical interface between biodiversity conservation and sustainable land management, requiring integrated approaches that combine preventive infrastructure , community-based mitigation, , spatial planning, and effective institutional support (MoAL & FAO, 2025; IPBES, 2019).

FGD and KII findings reinforce the survey results while highlighting variation across project landscape. Communities in Minjey (Lhuentse), Serthi (Samdrup Jongkhar), Khaling (Trashigang) and Sakteng (Trashigang) described HWC as a major constraint to agricultural production, with wild boars, monkeys, deer, porcupines, bears, wild dogs, and leopards frequently damaging crops and livestock. Respondents reported that repeated wildlife damage increase labour requirements for guarding fields, reduce confidence in farming, and, in some cases, contributes to the agricultural land abandonment. In contrast, respondents from Jurmed (Mongar), Decheling (Pemagatshel) and Martshala (Samdrup Jongkhar) reported relatively limited HWC because of the lower wildlife pressure or the widespread practice of stall-feeding livestock.

Qualitative findings also demonstrate the effectiveness of ongoing mitigation measures. Farmers in Langchenphu (Samdrup Jongkhar), Bumdeling and Ramjar (Trashiyangtse), Tsaenkhar (Lhuentse) and Nanong (Pemagatshel) reported that government-supported electric, solar and chain-link fencing has substantially reduced crop damage from wild pigs, barking deer and porcupines, although monkeys and birds remain difficult to control. Conversely, communities in Narang (Mongar), Martshala and Serthi (Samdrup Jongkhar) indicated that existing fencing is either insufficient or ineffective, highlighting the need for improved and context-specific mitigation measures.

The findings consistently indicate that HWC remains a widespread, recurrent, and predominantly of moderate to high severity across the project landscape. At the same time, they show that well-designed mitigation measures, particularly community-supported electric and chain-link fencing, can substantially reduce wildlife damage where appropriately implemented and maintained. The findings underscore the need to strengthen integrated HWC management through preventive infrastructure, community-based mitigation, landscape-level planning, and continued technical support to enhance community resilience while promoting coexistence between rural livelihoods and wildlife conservation.

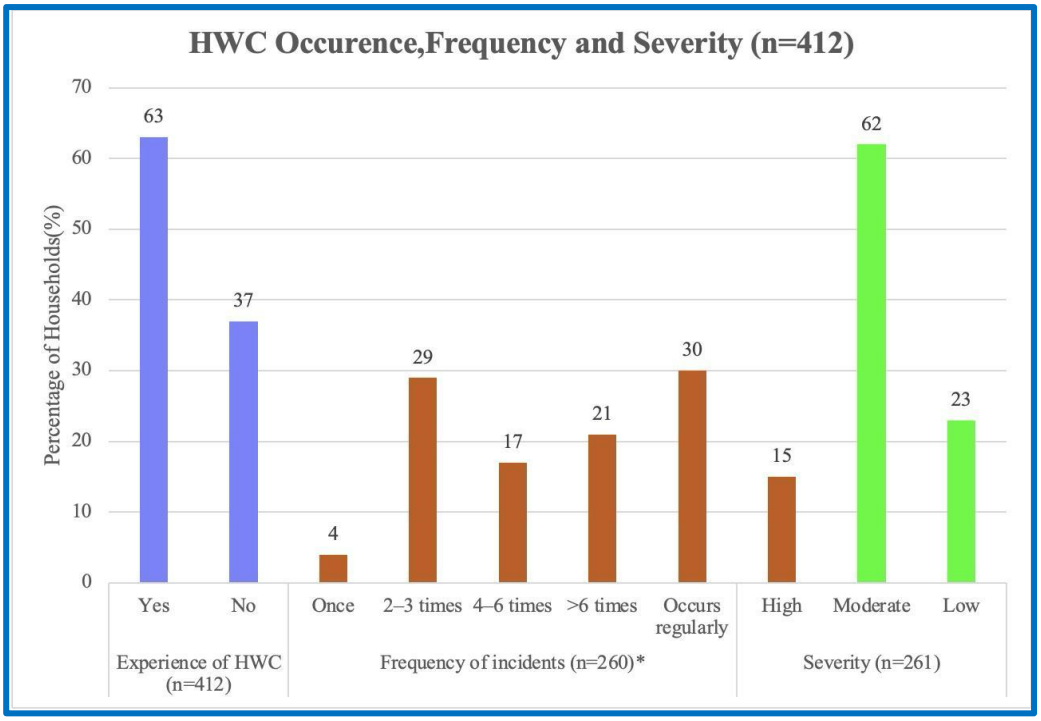


Figure 6.43: HWC occurrence, frequency and severity
(Source: Baseline HH Survey, 2026)
Note: *Frequency and severity percentages are calculated only for households that reported experiencing HWC (n = 261). *Frequency analysis is based on 260 households because of one missing response.*

The occurrence, frequency, and perceived severity of HWC varied considerably across the six project Dzongkhags (**Table 6.59**). Pemagatshel recorded the highest proportion of households experiencing HWC (82%), followed by Trashigang (76%), Lhuentse (66%), Trashiyangtse (55%), and Samdrup Jongkhar (52%), while Mongar reported the lowest prevalence (38%).

Among affected HH, HWC was generally recurrent across all Dzongkhags. Lhuentse recorded the highest proportion of HH reporting regular HWC incidents, indicating a chronic problem. Frequent and repeated incidents were also common in Samdrup Jongkhar and Trashigang, while HH in Pemagatshel and Trashiyangtse predominantly reported experiencing HWC two to six times during the reference period. Although Mongar recorded the lowest prevalence, affected HH still experienced recurring wildlife damage.

Perceived severity of HWC also varied across Dzongkhags. Lhuentse experienced the most severe impacts, with 86% of affected HH rating HWC as highly severe. In contrast, affected HH in Samdrup Jongkhar (86%), Trashiyangtse (77%), and Pemagatshel (76%) predominantly rated HWC as moderate. Trashigang and Mongar showed more varied severity levels, reflecting differences in the intensity of impacts among affected HH.

The overall findings indicate that while HWC affects all project Dzongkhags, its prevalence, recurrence, and severity vary considerably across locations, underscoring the need for location-specific mitigation and management strategies.

Table 6.59: Experience, frequency and severity of HWC by Dzongkhag

Dzongkhag	HHs (n)	HHs Affected (%)	HHs Not Affected (%)	Affected HHs (n)	HWC Incidents Frequency among affected HHs (%)					HWC severity among affected HHs (%)		
					Once	2–3 times	4–6 times	>6 times	Regular	High	Mod	Low
Lhuentse	32	66	34	21	5	0	0	5	90	86	14	0
Mongar	45	38	62	17	6	12	29	24	29	12	59	29
Pemagatshel	61	82	18	50	6	50	6	10	28	8	76	16
Samdrup Jongkhar	95	52	48	49	4	27	10	29	31	2	86	12
Trashigang	123	76	24	92	1	28	23	27	21	15	48	37
Trashiyangtse	56	55	45	31	6	29	32	16	16	0	77	23
Total	**412**	**63**	**37**	**260**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

(Source: Baseline HH Survey, 2026)

Note: *Percentages are calculated based only on HHs that reported the presence of HWC (n = 261). Therefore, the frequency and severity of HWC represent the HHs that experienced HWC rather than among all surveyed HH.*

6.13.6 Types of Human-Wildlife Conflict (HWC) Damage

The baseline findings indicate that crop damage is by far the most prevalent form of HWC experienced by affected HH (**Figure 6.44**). Of the 261 HH reporting HWC incidents, 249 HH (95%) identified crop damage, confirming that wildlife poses a substantial threat to agricultural production and HH food security across the project landscape.

Livestock loss was the second most frequently reported form of damage, affecting 16% (43 HH). Although much less common than crop damage, livestock predation remains an important concern for HH that depend on livestock for income and subsistence. Property damage was reported by 4% (10 HH), indicating that wildlife occasionally damages fences, storage facilities, or other HH assets. No HH reported human injury or death during the reference period, suggesting that the impacts of HWC are primarily economic rather than direct threats to human safety.

These findings are consistent with the literature, which identifies crop depredation and livestock predation as the principal impacts of HWC in Bhutan. Wild boar, deer, monkeys, bears, and other wild animals frequently damage crops and livestock, with annual crop losses estimated to range between 19% and 43%, undermining HH food security and farm incomes (MoAL, n.d.; MoAL, 2023; Sangay et al., 2008; Wangchuk et al., 2023). Increasing interactions between agricultural land and wildlife habitats further reinforce the need for integrated landscape-based HWC management (MoAL & FAO, 2025; IPBES, 2019).

FGD and KII findings corroborate the survey results. Across several project areas, farmers consistently identified crop damage as the most serious consequence of HWC. Communities in Minjey (Lhuentse), Serthi (Samdrup Jongkhar), Khaling (Trashigang), and Sakteng (Trashigang) reported frequent crop losses caused by wild boars, monkeys, deer, porcupines, bears, and wild dogs, while participants from Nanong (Pemagatshel) also highlighted damage to maize by Kalij pheasants. In contrast, respondents from Jurmed (Mongar), Decheling (Pemagatshel), and Martshala (Samdrup Jongkhar) reported relatively limited HWC, largely due to stall-feeding practices and lower wildlife pressure. KII participants further noted occasional livestock losses and poultry depredation by leopards, eagles, yellow-throated martens, and weasels

in Tsaenkhar (Lhuentse), Decheling (Pemagatshel), and Kangpar (Trashigang), although these incidents were generally localized and less widespread than crop damage.

The findings consistently demonstrate that HWC in the project landscape is predominantly characterized by crop damage, with livestock loss representing a secondary but important concern. It underscores the need to prioritize measures that protect crops while strengthening livestock protection in areas where predation remains significant. For mitigation measures that prioritize the protection of agricultural crops and livestock. Continued investment in electric, solar, and chain-link fencing, together with community-based wildlife deterrent systems and improved livestock protection, will be critical for reducing economic losses and enhancing the resilience of farming households.

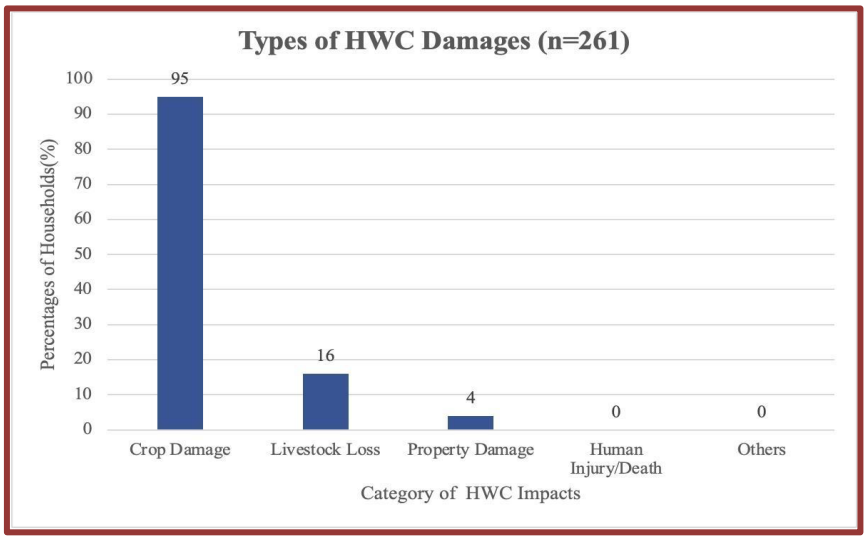


Figure 6.44: Types of HWC damages in past three years
*(*Source: Baseline HH Survey, 2026*)*
***Note:** Percentages are calculated only for HHs that reported being affected by the HWC (n = 261). Multiple responses were allowed; therefore, percentages exceed 100%.*

The pattern of HWC damage was broadly similar across the six Dzongkhags, with crop damage emerging as the predominant form conflict (HWC) in all project areas (**Table 6.60**). All HWC-affected HH in Lhuentse, Mongar, Pemagatshel, Samdrup Jongkhar, and Trashiyangtse reported crop damage, while 87% of affected HH in Trashigang reported similar losses, confirming crop depredation as the principal form of HWC across the project landscape.

Livestock loss was the second most common type of damage but varied considerably across Dzongkhags. It was most prevalent in Lhuentse (62%), followed by Trashiyangtse (23%), Mongar (18%), and Trashigang (16%), while relatively few affected HH in Samdrup Jongkhar (6%) and Pemagatshel (4%) reported livestock depredation. These differences suggest that livestock-related HWC is concentrated in specific locations and requires targeted mitigation measures.

Property damage was uncommon, reported only in Pemagatshel (6%)**,** Trashigang (6%), and Samdrup Jongkhar (2%). No cases of human injury or death were reported in any Dzongkhag during the reference period, while only one household in Samdrup Jongkhar reported other forms of wildlife-related damage.

The findings clearly indicate that although crop damage is the dominant form of HWC across all project Dzongkhags, livestock predation varies geographically and should be addressed through location-specific mitigation strategies, particularly in areas where livestock production forms an important component of household livelihoods.

Table 6.60: Types of HWC damages (n=261)

Dzongkhag	HH Reporting HWC(n)	Crop Damage (%)	Livestock Loss (%)	Property Damage (%)	Human Injury/Death (%)	Others (%)
Lhuentse	21	100	62	0	0	0
Mongar	17	100	18	0	0	0
Pemagatshel	50	100	4	6	0	0
Samdrup Jongkhar	49	100	6	2	0	2
Trashigang	93	87	16	6	0	0
Trashiyangtse	31	100	23	0	0	0
Total	**261**					

(Source: Baseline HH Survey, 2026)
Note**:** *Percentages are calculated only for HHs that reported being affected by the HWC (n = 261). Multiple responses were allowed; therefore, percentages exceed 100%.*

6.13.7 HWC Coping and Mitigation Measures

The baseline findings indicate that affected HH primarily rely on physical and labour-intensive measures to protect crop and livestock (**Figure 6.45**). Among the 261 HH reporting HWC, fencing was the most commonly adopted mitigation strategy (72%), followed by guarding (41%) and the use of deterrents such as noise-making devices, lights, and scarecrows (39%). These findings suggest that HH depend largely on direct protective measures to reduce wildlife damage.

In contrast, collective and adaptive approaches were used less frequently. Only 5% of affected households reported community-based protection measures, while 4% reported changes in farming practices to reduce vulnerability to wildlife damage. No households reported using insurance as a risk management mechanism, indicating that farming households largely bear the financial costs of HWC themselves. A small proportion of households (6%) reported taking no mitigation measures.

The findings are consistent with the literature, which emphasizes that effective HWC management requires a combination of preventive infrastructure, community participation, and coordinated landscape-level approaches rather than reliance on individual HH efforts alone (MoAL & FAO, 2025; IPBES, 2019). Measures such as electric fencing, community-based conflict management, and coordinated wildlife management have been identified as important for reducing crop and livestock losses while promoting coexistence between farming communities and wildlife (Wangchuk et al., 2023). The continued absence of insurance mechanisms in the survey further reflects a broader gap in risk-sharing arrangements for farming HH affected by HWC.

FGD and KII findings reinforce the survey results. Across most project areas, respondents identified electric, solar, and chain-link fencing as the primary means of reducing crop damage. Communities in Langchenphu (Samdrup Jongkhar), Bumdeling and Ramjar (Trashiyangtse), Tsaenkhar (Lhuentse), and Nanong (Pemagatshel) reported that that government- or project-supported fencing had substantially reduced losses from wild pigs, barking deer, and porcupines. However, participants also noted that fencing was less effective against all wildlife species. For example, farmers in Khaling (Trashigang) and Minjey (Lhuentse) reported that electric fencing effectively deterred most wild animals but remained less effective against monkeys, which continue to cause significant crop damage. Similarly, respondents from Narang (Mongar) and Martshala (Samdrup Jongkhar) highlighted the need for additional or improved chain-link fencing, as existing electric fencing provides only partial protection, particularly against species other than wild pigs.

The qualitative findings also indicate that, when fencing is unavailable or insufficient, HH continue to depend heavily on manual guarding and other labour-intensive deterrent measures. In Tsaenkhar (Lhuentse), farmers reported continuing to guard their fields despite the installation of chain-link fencing, while communities

in Serthi (Samdrup Jongkhar) emphasized that the absence of effective mitigation measures has reduced farmer confidence and discouraged long-term agricultural production. These findings suggest that although fencing has significantly reduced HWC in several locations, its effectiveness depends on the wildlife species involved, the quality and maintenance of the infrastructure, and complementary community-based management efforts.

The findings demonstrate that HWC mitigation in the project area is dominated by HH-level measures, particularly fencing, guarding, and deterrents. While these approaches have reduced wildlife damage in several communities, their effectiveness varies by wildlife species and local conditions, and they often require significant labour, maintenance, and financial investment. Expanding access to effective fencing technologies, strengthening community-based protection measures, improving technical support, and exploring sustainable risk-sharing mechanisms would help enhance household resilience and reduce wildlife-related losses.

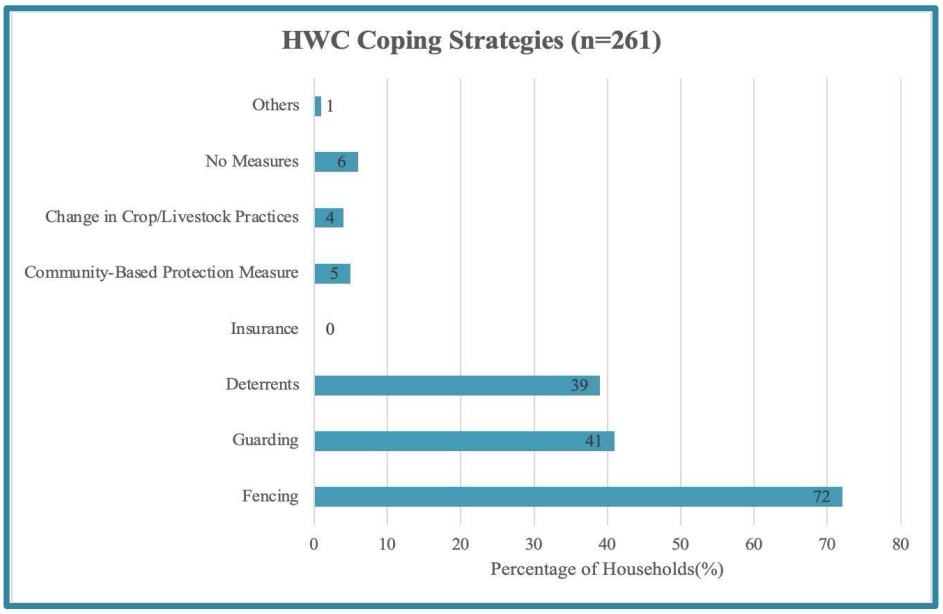


Figure 6.45: HWC coping and mitigation strategies
*(*Source: Baseline HH Survey, 2026*)*
***Note:** Percentages are calculated only for HHs that reported being affected by the HWC (n = 261). Multiple responses were allowed; therefore, percentages exceed 100%.*

The adoption of HWC mitigation measures varied across the six Dzongkhags (**Table 6.61**). Fencing was the dominant measure in most areas, with the highest adoption reported in Lhuentse (100%), Trashiyangtse (90%), and Trashigang (88%). High levels of fencing adoption suggest that HH view physical barriers as the most reliable means of protecting crops and livestock from wildlife. In contrast, Pemagatshel recorded the lowest use of fencing (32%), indicating greater reliance on alternative measures.

Guarding was particularly prevalent in Trashiyangtse (87%) and Samdrup Jongkhar (63%), while the use of deterrents was highest in Trashiyangtse (74%) and Pemagatshel (62%). These patterns suggest differing responses to local wildlife pressures and farming conditions.

Community-based protection measures and changes in farming practices were reported by only a small proportion of households across the project area, while no households reported using insurance as a risk management strategy. A notable proportion of households in Mongar (24%), Samdrup Jongkhar (24%), and Trashigang (24%) reported taking no mitigation measures, suggesting constraints in access to effective mitigation options or resources.

Overall, the findings indicate that HWC mitigation remains heavily dependent on household-level efforts, with limited adoption of collective, adaptive, or risk-sharing approaches. Strengthening community-based mitigation and expanding access to effective preventive measures could help improve the long-term management of HWC across the project landscape.

Table 6.61: HWC coping and mitigation strategies (n=261)

Dzongkhag	HH Reporting HWC(n)	Fencing (%)	Guarding (%)	Deterrents (%)	Insurance (%)	Community-Based Protection Measures (%)	Change in Farming Practice (%)	No Measures (%)	Others (%)
Lhuentse	21	100	5	5	0	10	0	0	0
Mongar	17	53	29	12	0	6	0	24	0
Pemagatshel	50	32	28	62	0	20	0	5	2
Samdrup Jongkhar	49	67	63	22	0	0	0	24	2
Trashigang	93	88	30	37	0	0	9	24	1
Trashiyangtse	31	90	87	74	0	0	10	0	0
Total	**261**								

(Source: Baseline HH Survey, 2026)

***Note**: Percentages are calculated using the number of HHs reporting HWC within each Dzongkhag as the denominator. Multiple responses were allowed; therefore, percentages do not sum up to 100%.*



Pics 7: Merak, Trashigang



Pics 8: Draewong, Khaling, Trashigang

7. Result Framework with Updated Baseline

This section presents an updated baseline value for the project's key outcomes and output indicators at the project landscape level as per the result framework form the ProDoc (**Table 7.1**). This baseline establishes the reference point against which project progress, performance, and outcomes will be monitored and evaluated over the implementation period.

The baseline values presented in the matrix are derived from the detailed findings of the HH survey (n=412), FGDs, for certain indicators, the original ProDoc baseline values are retained where the nature of the indicator precludes empirical measurement at the household level (e.g.., policy mechanisms, standards assessment). Additionally, supplementary contextual values are included where they support a more comprehensive understanding of the baseline conditions for outcomes and outputs.

The complete analysis and indicator values are presented in the main finding's sections, including disaggregation by Dzongkhag and, where relevant, by Gewog, gender, ages and social groups.



Pics 9: Women in Merak

Table 7.1: Baseline Result Indicator Matrix

Results chain	Indicators	Baseline	Updated baseline from HH Survey 2026	Final target	Means of verification	Assumptions
Project Objective: To improve the enabling environment and ensure the long-term environmental sustainability of food systems and delivery of the global environmental benefits (GEBs)						
Component 1: Supportive enabling conditions for sustainable and healthy food systems						
Outcome 1.1: Improved inter-sectoral collaboration mechanisms to support sustainable and healthy agri-food system transformation pathways	Inter-sectoral coordination forum for food system transformation established at national level	Inter-sectoral collaboration mechanisms do not exist at national level	No formal inter-sectoral coordination mechanism exists (Baseline unchanged)	Functional National inter-sectoral collaboration forum	Reports Minutes of meetings survey 2026	Sectoral actors are willing to collaborate.
	Number of environmentally sustainable agri-food products certified to international standards for export	Certification of dairy milk, cage-free eggs and yak products to specified standards is yet to be developed.	0 products certified to international standards; 7% HH have national-level certification (5% organic, 1% GAP, 1% other); 4% HH currently export products	Three agri-food products certified to specified standards for export	Certification standard, HH Survey 2026	Government has the ccapacity to develop certification to meet targeted international standards.
Output 1.1.1: Policies, plans, regulations, and investment guidance harmonized to promote sustainable food systems.	Inter-sectoral coordination forum for food system transformation exists	Inter-sectoral collaboration mechanisms do not exist at national level	No formal inter-sectoral coordination mechanism exists (Baseline unchanged)	National inter-sectoral collaboration forum functioning	Reports Minutes of meetings, HH Survey 2026	Sectoral actors are willing to collaborate.
	Number of policy reviews carried out within a SEA framework	0	0 (Baseline unchanged)	2	Impact assessment reports	Innovative and environmentally sustainable input supply solutions for food system resilience and global environmental benefits can be identified.
Output 1.1.2: Standards and certification developed to meet export	Number of international agri market standards	0 countries	0 (Baseline unchanged)	6 countries	Reports	PMU can complete assessments in a timely manner

market requirements for sustainable agricultural products	assessments completed					
	Number of environmentally sustainable agri-food products certified to specified standards for export	0	0 products certified to international standards	3 products	Certification standard, HH Survey 2026	BFDA has the capacity to develop the standards and complete the certification process before end of project.
Component 2: Transformation of food systems at farm, landscape and value chain levels						
Outcome 2.1: Farmers and SMEs with enhanced capacities adopt sustainable food production practices that deliver GEBs within a framework of integrated landscape management (ILM)	Metric tons of CO2e mitigated (Core Indicator 6)	0	0 tCO_2e (Baseline unchanged)	1,014,297 tonnes	ProDoc/PPG estimate; FAO NEXT tool at MTR/TE	Improved farm management practices based on NbS enhance GHG mitigation and support delivery of GEBs.
	Area of landscapes under improved practices (Core Indicator 4)	0	2,964 ha existing (13.4 ha SLM from HH survey + 2,949 ha rangeland restoration + 1.6 ha agro-silvopastoral)	1,130,746 ha	HH Survey 2026 and dzongkhag reports; GIS assessment (MTR/TE)	Improved farm management practices based on NbS enhance GHG mitigation and support delivery of GEBs.
Output.2.1.1: Enhanced support for sustainable production of food and integrated management of farming systems within a framework of ILM	Area of land and ecosystems under restoration (Core Indicator 4)	0	2,964 ha existing (as above)	1,130,746 ha	HH Survey 2026 and dzongkhag reports; GIS assessment (MTR/TE)	Farmers (women and men) are willing and able to adopt SLM ppractices that support biodiversity.
	The following rows are the details of the above total figures for area covered under Output 2.1.1					
	Area of landscapes under improved management to benefit biodiversity (Core Indicator 4.1	0	2,949 ha existing (rangeland restoration in Merak and Sakteng)	1,107,011 ha	Reports from dzongkhags, HH Survey 2026	Farmers (women and men) are willing and able to adopt SLM practices that support biodiversity.
	Area of landscapes under sustainable	0	13.4 ha existing (≈15 ha incl. agro-silvopastoral)	23,735 ha	Land ownership data (LULC, 2010)	Farmers (women and men) are willing and

	land management in production systems (Core Indicator 4.3)			{119 ha of SLM activities (2.1.1.6, 2.1.1.7 & 2.1.1.9) 23,616 ha (23,735 ha minus 119 ha) resulting from training farmers on SLM approaches (3.2.1.4)}	Report on SLM Training reports, HH Survey 2026	able to adopt SLM practices that support biodiversity conservation and climate resilience.
	Area (ha) covered by grazing (Tsamdrog) management plans/guidelines in Merak and Sakteng Gewogs (Core Indicator 3.1)	0	0 ha under formal management plans as there is no formal grazing management plan or guidelines; however, 2,949 ha under informal restoration practices (fencing 93%, rotational grazing 48%, reseeding 44%); Rangeland Condition Index = 0.558 & 20 hectares of grazing management through invasive species removal is done every year under Merak range	33,260 ha	Geospatial analysis Sakteng WS reports, HH Survey 2026	Sakteng Wildlife Sanctuary staff support the herders.
	Degraded rangeland areas (ha) under rangeland restoration (Core Indicator 3.1)	0	0 ha under restoration (15% (**2,795 ha)** of rangeland currently degraded (**18,633 ha**)	564 *{283 ha in Merak + 281 ha in Sakteng involving 560 HH}*	Geospatial analysis Sakteng WS reports, HH Survey 2026	Sakteng Wildlife Sanctuary staff support the herders.
	Area of pasture/fodder developed in dryland agriculture areas through agro-silvopastoral interventions (Core Indicator 4.1)	0	1.6 ha existing agro-silvopastoral systems; 39% HH practice agro-silvopastoral systems	405 ha {in Minjey, Silambi, Jurmey, Decheling, Martshala, Yangneer, Khamdang, Bumdeling, Ramjar}	Land ownership data (LULC) Report on SLM, HH Survey 2026	Farmers (women and men) are willing to undertake pasture/fodder development.

	No of farmers (disaggregated by gender) benefiting from rangeland, restoration fodder resources development and sustainable agriculture (Core Indicator 11)	0	0 individuals	84,419 (Women: 40,957, Men: 43,462)	Reports, HH Survey 2026	Farmers (women and men) are willing to undertake pasture land improvement and SLM.
Outcome 2.2: Agri-food system value chains and infrastructure favour sustainable and resilient supply chains	No. of climate-resilient and sustainable value chain enterprises established	Value chains exist, but are generally under-developed, not focused on environmental sustainability /provide low value returns to individuals, HH and enterprises, and business skills are weak	0 formal climate-resilient enterprises established; 25% HH undertake value addition; 19% access processing facilities; 37% use aggregators; 36% local markets; 4% export	7	Reports, HH Survey 2026	Farmers (women and men), SMEs and the private sector are willing to collaborate on improving value.
Output 2.2.1: Public private partnerships support investments for sustainable and resilient agricultural value chains that engage youth and are gender responsive	No. of women and men trained in environmentally sustainable agri-business and enterprise management	0	0 trained under project; baseline training access: Women 6%, Men 2%, Youth 2%, PwD 0% received training in last 12 months; 70% receive extension services (62% irregularly)	1,610	Reports, HH Survey 2026	Farmers, SMEs and the private sector are willing to collaborate on improving value chains and associated infrastructure.
Output 2.2.2: Agri-food value chain enterprises promote environmentally sustainable, resilient and gender responsive agricultural and livestock products	No. of enterprises on environmentally sustainable agri-food value addition and logistics established	0	Existing infrastructure include:1 food processing plant in Lumang gewog; 5 Dairy processing center-(Yangneer, Decheling, Minjey; Martshalla, Woongchillo;1 Yak and Sheep wool processing	7	Reports, HH Survey 2026	Farmers, SMEs and the private sector are willing to collaborate on improving value chains and associated infrastructure.

			center at Merak;1 cold storage at Khaling; 1 Rural Youth Processing and Marketing Enterprise under the Samjong Initiative in Gomdar; 1 Druk Arachis Peanut Processing Facility at Doksum Khamdang Gewog, Trashiyangtse;25% HH undertaking processing, packaging or branding before sale**;** 19% access to processing facilities.			
Component 3: Adaptive management and knowledge						
Outcome 3.1: Evidence- and result-based adaptive management	Food systems dashboard, including gender disaggregated data, operationalized and accessible	0	0 (Baseline unchanged)	Food system dashboard operationalized and accessible	Report	Project monitoring and knowledge products are relevant and useful to stakeholders.
Output 3.1.1: Monitoring mechanism with sustainability dimensions optimize effective, efficient and results-based adaptive management of agri-food system transformation	Food system dashboard, including gender disaggregated data, operationalized and accessible	0	0 (Baseline unchanged)	Food system dashboard operational	Reports	The food system dashboard is relevant and useful to farmers and government agencies in applying adaptive management to agri-food system transformation.
Outcome 3.2: Improved access to knowledge and technical expertise	No. of knowledge products developed and available on website of MoAL	0	0 (Baseline unchanged)	15	Knowledge products use survey Disseminated materials Reports from FSIP-GCP	Project knowledge and approaches are relevant and useful to stakeholders.

Output 3.2.1: Linkages to national, regional and global hubs/resources on sustainable agri-food systems and integrated landscape management established, enabling the management and exchange of knowledge and the stimulation of innovation and behaviour change.	Knowledge exchange and collaboration linkages to the FSIP-GCP and other FSIP countries established; (ii) NLC officials capacitated to carry out Land Use Zoning for eastern Bhutan	0	0 — institutional indicators, not directly measured by the household survey. Related farmer KAP baseline (Section 6.12): 70% of HH aware of sustainable practices; 60% knowledgeable on climate-resilient farming; 83% perceive productivity/environmental benefits; only 9% have received formal SLM training.	(i) FSIP-GCP and other FSIP-country linkages established and functioning; (ii) 200 NLC officials capacitated	Project reports; Reports from FSIP-GCP; Progress reports	Project staff and partners are willing to collaborate with the FSIP-GCP; NLC staff are willing to be trained.
	NLC officials capacitated to carry out Land Use Zoning for eastern Bhutan	0	0 (Baseline unchanged)	200	Progress Reports Training Attendance Training Certificates	Staffs are willing to get trained.

8. Strategic Recommendations for Project Implementation

Based on the baseline findings and the approved project logic, six strategic recommendations are proposed. Each is linked to the relevant approved project output(s)/activity(ies), the baseline evidence that justifies it, and the geographic/commodity priorities, so that it can directly inform Annual Work Plan and Budget (AWBP) preparation and PMU adaptive management, within the approved ProDoc scope.

1. Restore degraded landscapes through sustainable land management

Prioritize restoration of degraded and erosion-prone areas through SLM, agroforestry, soil and water conservation, and ecosystem restoration. Strengthen adoption through targeted interventions, demonstrations, technical support and community-based approaches.

Linked outputs/activities: Output 2.1.1 (sustainable production and integrated management of farming systems); SLM measures under activities 2.1.1.6, 2.1.1.7 and 2.1.1.9; farmer SLM training under activity 3.2.1.4.

Baseline evidence: only 19% of households currently apply SLM, on ≈13.4 ha (Tables 6.6/6.8); just 9% have received SLM training while 68% are willing to adopt with support; 16% report agricultural land degradation (LDI 0.163); rangeland degrading in Merak/Sakteng (RCI 0.558).

Geographic priority: erosion- and degradation-affected gewogs, notably the alpine rangelands of Merak and Sakteng (CI 3.1) and dryland gewogs reporting surface erosion/landslides.

AWPB entry point: demonstration sites, agroforestry/plantation inputs and SLM-training targets; CI 4.3 baseline ≈13.4 ha (≈15 ha incl. agro-silvopastoral) → target 23,735 ha.

2. Build climate-resilient agricultural and livestock systems

Promote climate-smart crop and livestock practices, resilient varieties, improved water management, sustainable fodder systems and adaptive rangeland management tailored to local agro-ecological conditions.

Linked outputs/activities: Output 2.1.1 (climate-smart practices within ILM; fodder/agro-silvopastoral development); rangeland restoration under CI 3.1.

Baseline evidence: 83% of households have experienced climate impacts (erratic rainfall, dry spells); CSAI 0.59 (≈4.1 of 7 practices adopted); rangeland RCI 0.558; 39% practise agro-silvopastoral systems (1.6 ha baseline).

Geographic/commodity priority: alpine rangelands (Merak/Sakteng) for adaptive grazing and fodder; climate-exposed dryland gewogs; dairy/livestock systems for improved fodder.

AWPB entry point: climate-resilient varieties, water-management and fodder-development lines; CI 4.1 agro-silvopastoral target 405 ha in Minjey, Silambi, Jurmey, Decheling, Martshala, Yangnyer, Khamdang, Bumdeling and Ramjar.

3. Shift smallholder production towards market-oriented value chains

Strengthen priority commodity value chains, including potato, vegetables, dairy, poultry and emerging commodities (quinoa), through producer aggregation, post-harvest management, value addition, processing, certification, finance and market linkages.

Linked outputs/activities: Outcome 2.2 (agri-food value chains and infrastructure), Outputs 2.2.1 (public–private partnerships for value-chain investment) and 2.2.2 (value-chain enterprises promoting environmentally sustainable, resilient products); and Output 1.1.2 (standards and certification for export markets).

Baseline evidence: value chains are constrained by low prices, limited market demand, transport bottlenecks and insufficient cold storage; only 25% of households undertake any value addition; 4% export and 7% hold certification.

Commodity priority: potato, vegetables, dairy, poultry and emerging quinoa (per the commodity plan), in their assigned producing gewogs.

AWPB entry point: producer-aggregation, post-harvest/cold-chain, processing, certification and market-linkage lines; certification of three products under Output 1.1.2.

4. Enhance food and nutrition security through diversified production systems

Promote integrated crop–livestock systems, diversified food production, home gardens, indigenous crops, improved storage and local processing to improve household food availability and resilience.

Linked outputs/activities: Output 2.1.1 (diversified, integrated crop–livestock production). Food and nutrition security is delivered through diversified production, as the approved ProDoc has no standalone nutrition output.

Baseline evidence: systems are diverse but subsistence-oriented (mean 3.2 crop varieties/HH, 80% traditional); food self-sufficiency and dietary diversity indicate seasonal gaps; limited storage and processing.

Geographic/commodity priority: food-insecure and remote gewogs; home gardens and indigenous crops; smallholder mixed farms.

AWPB entry point: home-garden, seed/variety, storage, local-processing and nutrition-sensitive lines.

5. Strengthen inclusive institutions and implementation capacity

Enhance farmer organisations, extension services and local institutions through gender- and youth-responsive capacity building, stronger coordination and improved stakeholder partnerships to sustain project outcomes.

Enhance farmer organisations, extension services and local institutions through gender- and youth-responsive capacity building, stronger coordination and improved stakeholder partnerships.

Linked outputs/activities: Output 3.2.1 (improved access to knowledge, technical expertise and advisory services); inter-sectoral coordination under Outcome 1.1.

Baseline evidence: extension and training gaps (9% received SLM training, 4% soil testing); women play a central farm-decision role with comparatively limited extension access; organizational membership modest (Community Forest 33.5%, Farmer groups 24.3%).

Geographic/gender priority: women-managed farms and gewogs with low extension coverage; youth engagement.

AWPB entry point: gender- and youth-responsive capacity building, extension strengthening and farmer-group support lines.

6. Strengthen the project M&E and data-management system

Establish a robust monitoring, evaluation and data-management system — including spatial (GIS) verification of area-based (ha) indicators, systematic gender-disaggregated beneficiary tracking, and streamlined Results Framework and FSIP-GCP reporting — to ensure reliable baseline-to-endline comparability and evidence-based adaptive management.

Linked outputs/activities: Output 3.1.1 (monitoring mechanism with sustainability dimensions); Output 3.2.1 (food-systems dashboard and knowledge products); Outcome 3.1 (evidence- and results-based adaptive management).

Baseline evidence: the baseline itself showed the need — area (ha) indicators require GIS/spatial verification (the CI 4.3 SLM area required reconciliation; rangeland areas were unreliable); CI 11 beneficiary counts need consistent gender-disaggregated tracking; multiple-response and unit conventions need standardisation.

AWPB entry point: M&E system set-up, GIS/spatial verification of ha indicators, a gender-disaggregated beneficiary database, dashboard operationalisation and FSIP-GCP reporting lines.



Pics 10: Ramjar, Trashiyangtse



Pics 11: Khaling, Trashigang



Pics 12: Bumdeling, Trashiyangtse

9. Conclusion

The baseline assessment establishes a robust evidence base for guiding implementation, monitoring progress, and evaluating the impacts of the GEF-8 project *Productive and Sustainable Food Systems in Bhutan for Environmental Benefits and Gross National Happiness*. Based on a survey of 412 households across 23 Gewogs, complemented by GIS analysis, focus group discussions, and key informant interviews, the assessment confirms that the project landscape is characterised by extensive natural ecosystems, rich agrobiodiversity, and strong community dependence on natural resources, while facing significant environmental, agricultural, and livelihood challenges.

The project landscape contains approximately 1.03 million ha of natural habitat (91% of the total area), with 92% of households living in close proximity to forests and maintaining a relatively diverse agricultural system, averaging 3.2 crop varieties per household, of which 80% are traditional or local varieties. These ecological and agricultural assets provide a strong foundation for promoting sustainable food systems while conserving biodiversity and strengthening climate resilience.

Land degradation and climate vulnerability are among the principal environmental challenges. Approximately 16 % of households reported agricultural land degradation, while only 19% of households currently adopt Sustainable Land Management (SLM) practices, despite 68% of households expressing willingness to adopt such practices. In addition, 83% of households have already experienced climate-related impacts, particularly erratic rainfall.

Agricultural production remains largely smallholder and subsistence-oriented. Fragmented landholdings, limited irrigation coverage (47% of households), low levels of value addition, certification and market integration, together with declining productivity in several farming systems, continue to constrain household incomes and agricultural competitiveness. Although agriculture remains the principal livelihood for most households, 35% of households experience seasonal food shortages, while 63% of surveyed households reported significant crop and livestock losses from human-wildlife conflict, highlighting persistent vulnerabilities within the production system. These interconnected challenges highlight the need for integrated interventions that address production, natural resource management, markets and household resilience rather than treating them as isolated issues.

Despite these challenges, the baseline demonstrates considerable opportunities for transformation. Strong farmer awareness of sustainable agriculture, high interest in adopting SLM practices, widespread maintenance of traditional crop diversity, existing agroforestry practices, and well-established community institutions provide a favourable enabling environment for project implementation. Achieving the project's environmental and livelihood objectives will require an integrated landscape approach that simultaneously addresses land degradation, climate resilience, sustainable agricultural intensification, biodiversity conservation, market development, and social inclusion. The baseline indicators established through this assessment provide the reference point for tracking project performance, informing adaptive management, and assessing outcomes and impacts at midline and endline. Continued strengthening of data quality, monitoring and learning will be essential to ensure that implementation remains evidence-based and responsive to changing environmental, climatic and socio-economic conditions.

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