LoGIC
Strengthening Locally Led Climate Actions

CROSS-SECTIONAL ANALYSIS OF THE CLIMATE ADAPTIVE LIVELIHOOD OPTIONS (CALO) IN CLIMATE STRESSED AREAS OF BANGLADESH

Final Report

Local Government Initiative on Climate Change (LoGIC)

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Disclaimer

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EXECUTIVE SUMMARY

The Local Government Initiative on Climate Change (LoGIC) project, a collaborative effort between the Government of Bangladesh, UNDP, UNCDF, the Embassy of Sweden, and the Embassy of Denmark, aims to bolster the capacity of vulnerable communities, local government institutions, and civil society organizations in planning and financing climate change adaptation solutions. Originally LoGIC project was initiated in 2016 with support from the European Union, SIDA, UNDP, and UNCDF for four years, the project has received extensions until June 2025 following an independent assessment affirming its success.

Bangladesh, ranked among the most climate-affected nations, faces severe climate-related challenges such as altered rainfall patterns, rising temperatures, and frequent extreme weather events like cyclones and floods. These issues exacerbate salinity in water and soil, impacting the economy and increasing poverty and vulnerability. The Bangladesh government has integrated climate change concerns into national development policies, guided by the Bangladesh Climate Change Strategy and Action Plan (BCCSAP 2009). However, local government institutions often lack the capacity to effectively implement climate adaptation plans, a gap that LoGIC aims to fill.

LoGIC targets approximately 500,000 vulnerable households across various districts in Bangladesh. The project's comprehensive approach includes building capacity, raising awareness, empowering communities and local governments, developing local climate adaptation plans, and providing grants for community-based adaptation projects. By integrating high-quality accountability and participation at all levels, LoGIC seeks to reduce poverty and vulnerability.

The project, spanning 96 months from July 2017 to June 2025, is overseen by a Project Steering Committee comprising multiple ministries and development partners. A Project Management Unit managed jointly by UNDP and UNCDF supports the Local Government Division. The project's total budget is approximately $45.48 million, funded by various international donors.

Objectives of the Study

The Community Resilience Fund (CRF) was created to support the most vulnerable women in climate change hotspots across Bangladesh. The CRF has been instrumental in implementing Climate Adaptive Livelihood Options (CALOs), which aim to sustain livelihoods despite environmental changes and shocks. These options encompass a broad understanding of well-being beyond mere income or employment generation, including access to shelter, food, health, mobility, recreation, water and sanitation, and social life.

The primary objective of this study was to assess the role of the LoGIC CRF support and selected CALOs in promoting climate-resilient livelihood options for the beneficiary households. Specific objectives include:

- Evaluating the environmental, social, and economic viability of CALOs in various contexts.
- Conducting a technical analysis of existing CALOs and identifying potential innovations.
- Presenting scalable CALOs based on on-site assessments.
- Assessing the effectiveness of CRF-supported climate-adaptive livelihood options.
- Evaluating the role of Community Mobilization Facilitators (CMFs), Upazila Line Departments, and local resource persons in the success of these options.

- Assessing the impact of CALOs on household well-being and the local economy.
- Understanding the level of climate adaptive livelihoods among CRF beneficiaries.
- Evaluating the gender-specific impacts of CALOs.
- Identifying potential stakeholders for the marketability of CALOs.

Geographical Coverage

The study covers 11 districts across Bangladesh, representing diverse and climatically sensitive regions. This wide geographical coverage ensures a comprehensive understanding of the varied impacts of climate change and the effectiveness of CALOs across different ecological zones.
The study utilized a mixed-method approach, integrating quantitative, qualitative, and secondary data collection methods to evaluate the effectiveness, impact, and adaptability of CALOs in regions where they were implemented. In areas poised for the next phase of CALO implementation, the strategy focused on secondary document reviews and qualitative analyses to assess contextual appropriateness and identify the most promising CALOs.

Methodology

The study conducted by DM WATCH for the Local Government Initiative on Climate Change (LoGIC) project utilized a comprehensive methodological workflow that blended quantitative and qualitative research methods to assess the effectiveness of Climate Adaptive Livelihood Options (CALOs). The methodology was structured into four key phases, ensuring thorough data collection, analysis, and reporting.
Phase 1: Preparatory and Planning Phase

Phase 2: Data Collection Phase

Phase 3: Data Processing and Analysis Phase

Phase 4: Reporting and Dissemination Phase

Data Collection Approach

The study employed a mixed-method approach for collecting data from secondary and primary sources.

- Secondary Documents Review
  An extensive review of secondary documents was undertaken to establish a contextual background, understand the current state of research, and identify gaps in knowledge.

- Primary Data Collection
  Quantitative Survey Methodology: Beneficiaries of CALOs were identified using the project's beneficiary list, focusing on those involved with specific CALOs supported by the Community Resilience Fund (CRF). A stratified random sampling strategy was used to select survey respondents.

Qualitative Data Collection: This included purposive sampling, Key Informant Interviews (KIIs), Focus Group Discussions (FGDs), and case studies to capture the nuanced perspectives of beneficiaries and other stakeholders.

Sampling Strategies

- Quantitative Sampling: The study employed stratified random sampling to ensure diverse experiences were represented across four distinct agroecological zones.
- Qualitative Sampling: A total of 123 participants were involved, including individuals for KIIs, FGDs, and detailed case studies.

Analytical Model

The study utilized both qualitative and quantitative data analyzed according to set objectives. Quantitative data was analyzed using descriptive statistics, while qualitative data was processed through content analysis and thematic coding. The Sustainable Livelihoods Approach was employed to determine the environmental, social, and economic viability of CALOs.

Gender analysis was incorporated to identify and explain gaps between men and women, focusing on gender norms and power relations. This approach ensured that gender equality and the empowerment of women were thoroughly addressed throughout the program's lifecycle.

Triangulation was used to combine quantitative and qualitative methodologies, ensuring objective analysis and identifying gaps or inconsistencies in the research results.

Environmental, Social, Economic Viability, and Gender Impact Analysis of CALOs

This chapter provides a comprehensive analysis of the environmental, social, and economic viability of various Climate Adaptive Livelihood Options (CALOs) and examines their gender impacts. The findings are based on both quantitative and qualitative data collected from CALO beneficiaries.

Demographic Profile of Respondents

- Gender: The survey population predominantly consists of females (98.4%).
- Age Distribution: The majority of beneficiaries are between 31-40 years (33.8%), followed by 41-50 years (28.4%).
- Income Activities: 61% of beneficiaries are engaged in other income-earning activities, primarily livestock (42.6%), housewives (17.7%), and day laborers (16.2%).
- Household Size: Most households consist of 4-6 members (64.5%).
- Duration of Involvement: The majority of beneficiaries have been involved in CALOs for 25-36 months (39.6%).

Income and Expenditure Patterns

- Income from CALOs: The largest segment earns between 1001 to 2000 Taka (22.7%). However, 12.7% have not earned any income from CALO activities.
- Total Household Income: A significant portion (38.1%) has a total household income ranging from 10001 to 15000 Taka.
- Expenditure: Most beneficiaries spend between 5001 to 10000 Taka (37.8%) and 10001 to 15000 Taka (37.9%).

Understanding of Climate Adaptive Livelihoods

- Awareness: 69.5% of respondents have heard about climate adaptive livelihoods.
- Knowledge: Among those aware, 86.5% possess correct knowledge about climate adaptive livelihoods.
- Perception of Importance: 72.5% consider adopting climate adaptive livelihoods as very or extremely important.

CALO-Wise Environmental, Social, and Economic Viability

1. Brackish water Fish Polyculture

Brackish water Fish Polyculture shows high physical capital (90%) and strong social capital (80%), indicating a robust infrastructure and community support. However, it faces challenges with moderate natural capital (66%) and human capital (77%), reflecting issues with environmental conditions and workforce skills. To enhance its viability, it is recommended to improve environmental management practices and financial mechanisms.

2. Carp Polyculture

Carp Polyculture demonstrates high physical capital (90%) and social capital (74%), which suggests strong infrastructure and community engagement. Despite these strengths, it faces challenges with moderate natural capital (67%) and human capital (66%). To improve sustainability, there should be a focus on enhancing environmental practices and economic resilience.

3. Crab Fattening

Crab Fattening benefits from strong physical capital (82%) and social capital (82%), indicating solid infrastructure and community cooperation. However, it has moderate natural capital (63%) and human capital (76%), which highlight the need for better environmental practices and health services. Addressing these challenges will improve its overall viability.

4. Duck & Fish Farming

This CALO shows robust physical capital (86%) and social capital (82%), indicating strong infrastructure and community support. However, it struggles with natural capital (62%) and human capital (66%). Strengthening environmental practices and diversifying income sources are recommended to enhance its viability.

5. Duck Rearing

Duck Rearing has high physical capital (89%) and social capital (80%), reflecting good infrastructure and community support. It faces challenges with natural capital (73%) and human capital (71%). To improve its effectiveness, there should be a focus on enhancing natural resource management and health infrastructure.

6. F-1 Calf Rearing

F-1 Calf Rearing displays high physical capital (88%) and exceptional social capital (92%), indicating robust infrastructure and strong community ties. However, it has lower human capital (64%) and financial stability. Enhancing training programs and health services is recommended to address these challenges.

7. Green Job (Bamboo-based Handicraft)

This CALO shows strong human capital (80%) and financial capital (83%), indicating skilled workers and good financial resources. However, it faces challenges with natural capital (63%) and economic diversification. Focusing on environmental practices and diversifying economic activities will enhance its sustainability.

8. Integrated Agriculture and Poultry

Integrated Agriculture and Poultry has high physical capital (86%) and financial capital (73%), indicating strong infrastructure and financial support. However, it has lower social capital (64%) and natural capital (72%). Strengthening community engagement and improving environmental management are essential for its success.

9. Integrated Agriculture Farming

This CALO shows high physical capital (90%) and social capital (78%), reflecting robust infrastructure and community support. It faces challenges with natural capital (75%) and human

capital (69%). Enhancing educational programs and sustainable practices is recommended to improve its viability.

10. Integrated Vegetable Cultivation

Integrated Vegetable Cultivation benefits from high physical capital (94%) and social capital (81%), indicating strong infrastructure and community support. However, it faces challenges with natural capital (77%) and human capital (68%). Improving training and sustainable cultivation practices will enhance its effectiveness.

11. Maize Cultivation

Maize Cultivation shows high physical capital (94%) and social capital (79%), suggesting strong infrastructure and community engagement. However, it faces challenges with natural capital (77%) and human capital (68%). Adopting soil conservation techniques and diversifying income sources are recommended to improve its sustainability.

12. Mung Bean Cultivation

Mung Bean Cultivation has high physical capital (97%) and social capital (83%), indicating robust infrastructure and community support. It faces challenges with natural capital (71%) and human capital (70%). Implementing salinity management and enhancing financial planning will improve its viability.

13. Native Chicken Rearing

Native Chicken Rearing displays high physical capital (95%) and social capital (74%), reflecting strong infrastructure and community engagement. It faces challenges with natural capital (68%) and human capital (70%). Focusing on natural resource management and health services is recommended to address these issues.

14. Native Poultry Rearing

Native Poultry Rearing shows strong physical capital (95%) and social capital (72%), indicating robust infrastructure and community support. However, it faces challenges with natural capital (59%) and financial stability. Enhancing natural capital and diversifying economic activities will improve its sustainability.

15. Pig Rearing

Pig Rearing benefits from excellent physical capital (95%) and social capital (83%), indicating strong infrastructure and community cooperation. It faces challenges with natural capital (72%) and human capital (60%). Implementing sustainable grazing practices and improving financial literacy are recommended to address these challenges.

16. Saline Water Fisheries

Saline Water Fisheries shows strong physical capital (81%) and social capital (73%), indicating good infrastructure and community support. However, it faces challenges with human capital (62%) and financial returns. Enhancing human capital and environmental practices will improve its overall viability.

17. Sheep and Duck Rearing

Sheep and Duck Rearing has strong physical capital (79%) and social capital (72%), indicating robust infrastructure and community support. It faces challenges with human capital (60%) and natural capital (72%). Improving health services and financial planning are essential for its success.

18. Sheep Rearing

Sheep Rearing displays excellent physical capital (92%) and social capital (82%), reflecting strong infrastructure and community support. It faces challenges with human capital (72%) and financial stability. Enhancing education and health infrastructure is recommended to address these issues.

19. Stress Tolerant Vegetable Cultivation

This CALO shows strong physical capital (77%) and social capital (70%), indicating good infrastructure and community engagement. However, it faces challenges with human capital (68%) and natural capital (77%). Improving skill training and sustainable farming techniques will enhance its effectiveness.

20. Watermelon Cultivation

Watermelon Cultivation benefits from high physical capital (100%) and moderate social capital (64%), indicating strong infrastructure but needing better community support. It faces challenges with natural capital (70%) and financial stability. Focusing on financial literacy and improving market access will enhance its sustainability.

21. Sunflower Cultivation

Sunflower Cultivation shows moderate physical capital (61%) and social capital (55%), indicating the need for improved infrastructure and community engagement. It faces challenges with financial stability and market access. Implementing financial education and improving market linkages are essential for its success.

22. Vermicompost

Vermicompost displays high physical capital (79%) and social capital (63%), indicating good infrastructure and community support. However, it faces challenges with human capital (58%) and financial stability. Focusing on training and sustainable practices will enhance its viability.

Marketability of CALOs

The marketability of Climate Adaptive Livelihood Options (CALOs) was assessed using the PESTEL framework, which analyzes the Political, Economic, Social, Technological, Environmental, and Legal factors influencing the market potential of these livelihood options.

High Marketability CALOs:

Stress Tolerant Vegetable Cultivation: This CALO is highly marketable due to its resilience to adverse climatic conditions, ensuring consistent production and supply. The high demand for vegetables, combined with the ability to produce them sustainably, enhances market access and profitability.

Mung Bean Cultivation: Mung beans are in high demand both domestically and internationally. Their ability to grow in varied climatic conditions and their nutritional value make them a highly marketable crop. The strong market demand ensures good prices and economic returns for farmers.

Green Jobs (Bamboo-based Handicrafts): Handicrafts made from bamboo are popular due to their eco-friendliness and cultural significance. There is a growing market for sustainable and artisanal products, which makes bamboo-based handicrafts highly marketable. These products appeal to both local and international markets, enhancing their profitability.

Moderate Marketability CALOs:

Pig Rearing: Pig rearing has moderate marketability due to the high demand for pork products. However, challenges such as disease management, feed costs, and market access can affect profitability. Improving veterinary services and establishing better market linkages can enhance its marketability.

Duck and Fish Farming: These activities have a steady demand, particularly in regions where fish and duck meat are staple foods. The marketability can be improved by adopting better management practices, enhancing product quality, and exploring new market avenues.

Integrated Agriculture and Poultry: This CALO benefits from diversified income sources, making it moderately marketable. Enhancing market access and adopting sustainable farming practices can further improve its economic viability.

Benefit-Cost Analysis (BCA)

The Benefit-Cost Analysis (BCA) evaluates the economic viability of CALOs by comparing the total expected costs with the benefits derived from these activities. This analysis helps in determining the profitability and sustainability of each CALO.

High Performers:

Sheep Rearing: Sheep rearing shows a high return on investment due to low maintenance costs and high market demand for sheep products, including meat and wool. The strong community support and well-established infrastructure contribute to its economic viability.

Mung Bean Cultivation: This CALO demonstrates strong economic returns due to the high market demand and relatively low input costs. The ability to grow mung beans in diverse climatic conditions further enhances its profitability.

Moderate Performers:

F-1 Calf Rearing: This activity shows moderate profitability due to the high initial investment and ongoing maintenance costs. However, the demand for beef and dairy products ensures a steady income. Improving veterinary services and feed quality can enhance profitability.

Integrated Agriculture and Poultry: The combination of crop cultivation and poultry farming offers diversified income streams, but the profitability varies based on market access, input costs, and environmental conditions. Adopting better farming practices and enhancing market linkages can improve economic returns.

Gender Impact Analysis

The gender impact analysis assesses the socio-economic advancements and empowerment of women through the implementation of CALOs.

Positive Impacts:

Crab Fattening: This activity has significantly improved women's income and economic independence. Women involved in crab fattening have gained better access to financial resources and have enhanced their decision-making power within households and communities.

Bamboo-based Handicrafts: Women engaged in bamboo-based handicrafts have benefited from increased income and improved skills. This CALO has also enhanced women's social status and participation in economic activities, contributing to their overall empowerment.

Areas for Improvement:

Sunflower Cultivation: While this activity has provided stable income, the overall financial benefits have been limited. There is a need to improve women's access to markets and financial services to enhance the economic impact.

Integrated Agriculture and Poultry: Although this CALO offers diversified income sources, the benefits to women have been moderate. Enhancing training programs and providing better access to resources can improve the socio-economic impact on women.

Evaluation of CALOs in Terms of Resilience to Climate Change

This chapter evaluates the resilience of various Climate Adaptive Livelihood Options (CALOs) in different regions of Bangladesh, focusing on their ability to adapt to and mitigate climate-related vulnerabilities. The assessment covers multiple agroecological zones, each facing unique climatic challenges.

Climatic Conditions and Vulnerability Analysis

- **Active Tista Floodplain (Zone 2) - Kurigram**

Geographical and Environmental Context: The landscape is dominated by the dynamics of the Tista, Dharla, and Dudhkumar rivers, characterized by non-calcareous alluvium soils with moderate acidity.

Climatic Conditions: The region experiences substantial rainfall during the monsoon, leading to extensive flooding, which enriches the soil but also causes erosion.

Vulnerabilities: Agriculture, livestock, fisheries, infrastructure, and public health are significantly affected by repeated flooding.

Implemented CALOs: Stress-tolerant vegetable cultivation, maize cultivation, native chicken rearing, F-1 calf rearing, integrated agriculture, and vermicompost projects.

Challenges: Scalability, community adoption, and long-term sustainability remain issues.

- **Sylhet Basin (Zone 21) - Sunamganj**

Geographical and Environmental Context: Encompasses the lower western side of the Surma-Kushiyara floodplain with soils that dry seasonally.

Climatic Conditions: Prone to heavy rainfall and flash floods during the pre-monsoon season.

Vulnerabilities: Agriculture, fisheries, livestock, human settlements, and health.

Implemented CALOs: Duck and fish farming, integrated agriculture and poultry systems, short-duration crop varieties, and infrastructure enhancements.

Challenges: Land use conflicts, inadequate infrastructure, and the need for more comprehensive policy enforcement.

- **Ganges Tidal Floodplain (Zone 13) - Khulna, Bagerhat, Barguna, Patuakhali**

Geographical and Environmental Context: Extensive tidal land with significant areas of salinity.

Climatic Conditions: Influenced by the monsoon with tidal activities affecting agricultural patterns.

Vulnerabilities: Agriculture, infrastructure, public health, and environmental degradation.

Implemented CALOs: Brackishwater and carp fish polyculture, crab fattening, stress-tolerant vegetable varieties, integrated farming systems, and sustainable practices.

Challenges: Land use conflicts, inadequate infrastructure resilience, and the need for effective water management.

- **Young Meghna Estuarine Floodplain (Zone 18) - Bhola**

Geographical and Environmental Context: Characterized by young alluvial lands with soils low in nitrogen and organic matter.

Climatic Conditions: Influenced by seasonal monsoons and tidal fluctuations.

Vulnerabilities: Agriculture, water resources, human settlements, and livelihoods.

Implemented CALOs: Duck and fish farming, carp fish polyculture, stress-tolerant vegetables, integrated farming systems, and native chicken rearing.

Challenges: Infrastructure degradation, water management inefficiencies, and enhanced community resilience.

- **Northern and Eastern Hills (Zone 29) – Rangamati and Bandarban**

Geographical and Environmental Context: Features complex relief with steep slopes and brown hill soil with low fertility.

Climatic Conditions: High rainfall intensity leading to soil erosion and landslides.

Vulnerabilities: Water resources, agriculture, biodiversity, human settlements, and livelihoods.

Proposed CALOs: Agroforestry, rainwater harvesting, resilient crop varieties, and diversified livelihood strategies.

Challenges: Addressing water scarcity, promoting sustainable agricultural practices, and strengthening community disaster preparedness.

Effectiveness of CALOs in Reducing Climate-Related Risks

The adaptability of CALOs was assessed through respondents' perceptions across various metrics, including their ability to cope with extreme temperatures, drought, rainfall fluctuations, saline intrusion, cyclones, storm surges, and pest and disease outbreaks.

High Adaptability: CALOs such as crab fattening, watermelon cultivation, vermicompost production, integrated agriculture farming, and resilient crop varieties have shown significant effectiveness in adapting to climate-related risks.

Moderate Adaptability: Integrated agriculture and poultry, duck and fish farming, native chicken rearing, and maize cultivation displayed moderate adaptability.

Low Adaptability: Some CALOs like sunflower cultivation, carp fish polyculture, and sheep rearing exhibited lower adaptability, indicating the need for further support and strategic interventions.

Stakeholder Involvement Analysis

Understanding the involvement of various stakeholders from national to local levels is critical for the success of CALOs. The stakeholder analysis reveals the roles and effectiveness of strategic, tactical, operational, and community stakeholders in implementing CALOs.

National Level

Local Government Division (LGD): As the main overseeing body, LGD collaborates closely with relevant ministries and international partners such as UNDP, UNCDF, and donor agencies to ensure strategic alignment and resource allocation for CALO implementation. Their influence is critical for policy-making and funding, which supports the scaling and sustainability of CALOs.

Effectiveness: Their involvement ensures that CALOs are integrated into broader policy frameworks, enhancing their impact and sustainability. The strategic guidance from national stakeholders helps address macroeconomic challenges and align project activities with national climate resilience goals.

Technical Stakeholders

UNDP and UNCDF: These organizations provide essential technical support and innovation by designing technical solutions, offering training, and ensuring that CALOs are scientifically sound, practically feasible, and meet high standards of resilience and adaptability.

Effectiveness: Their technical expertise and strategic planning have been pivotal in enhancing the resilience and adaptability of CALOs, ensuring that they are tailored to local conditions and needs.

Operational Stakeholders (Local Level)

Local Government Institutions (LGIs) and Civil Society Organizations (CSOs): These entities execute climate-resilient plans, provide essential training and capacity building at the grassroots level, and translate strategic plans into actionable, context-specific interventions.

Effectiveness: The effectiveness of operational stakeholders varies, with strong local support for some CALOs like vermicompost and stress-tolerant vegetables, while others like sunflower cultivation and integrated agriculture and poultry show gaps, necessitating enhanced local capacity and coordination for success.

Community Stakeholders

Beneficiary Engagement: Involving vulnerable households and women, is crucial for tailoring CALO interventions to local needs, ensuring initiatives address specific challenges and enhance adaptive capacity.

Effectiveness: Community stakeholders' high engagement in several CALOs has improved income and resilience, but effectiveness varies by region, emphasizing the need for ongoing community involvement and feedback mechanisms.

Partnerships

Collaborations with Organizations like BRAC and BUET: These partnerships enhance the capacity and market access of CALO beneficiaries. Training modules, financial inclusion programs, and market linkage initiatives provided by these organizations have been crucial for the success of CALOs.

Effectiveness: These collaborations have significantly impacted income and expenditure patterns among beneficiaries, demonstrating the importance of strategic partnerships in enhancing the sustainability and effectiveness of CALOs.

The comprehensive evaluation of CALOs highlights their potential to enhance resilience against climate change in various regions of Bangladesh. Effective stakeholder involvement, strategic partnerships, and tailored support are crucial for addressing the specific challenges and leveraging the strengths of each CALO. Continuous assessment, community engagement, and strategic

interventions are essential for ensuring the long-term sustainability and success of climate adaptive livelihood options.

Cross-Sectional Analysis of CALOs

This chapter provides a detailed cross-sectional analysis of Climate Adaptive Livelihood Options (CALOs), considering climate hotspots, geographical conditions, the socio-economic context of beneficiaries, and adaptive capacity. It examines the economic impact on households, focusing on income changes, expenditure patterns, employment opportunities, and the specific economic impacts on women. Additionally, the chapter explores the social and health impacts on households, including food security, healthcare accessibility, safety, shelter, and overall adaptive capacity.

Economic Impact on Households

The economic impact of CALOs on households was analyzed through various metrics: Income Changes: Activities like maize cultivation and native poultry rearing showed significant income increases, with 60.8% and 63.3% of participants reporting higher earnings, respectively. In contrast, sunflower cultivation and watermelon cultivation had negligible economic changes, with 84% and 48% of participants reporting no significant shifts.

Expenditure Patterns: The impact on expenditure varied across CALOs. For instance, Green Job (Bamboo-based Handicraft) reported a 100% increase in expenditure, while F-1 Calf Rearing saw 50% of participants reporting decreased expenditures. Sunflower and watermelon cultivation showed stable expenditures for most participants.

Employment Opportunities: CALOs like pig rearing and maize cultivation were unanimously recognized for creating more job opportunities. In contrast, sunflower cultivation faced skepticism, with a significant portion of participants disagreeing about its job creation potential.

Economic Impact on Women: Women involved in CALOs experienced substantial income boosts and improved access to financial resources. However, traditional norms and limited market access posed challenges in certain regions.

Social and Health Impact on Households

The implementation of CALOs has led to notable improvements in various aspects of social and health conditions among beneficiaries:

Food Security: The US Food Security Survey Module (FSSM) assessed food security status. Regions like the Active Tista Floodplain showed high food security (98.8%), while the Ganges Tidal Floodplain had significant food insecurity (51.1%).

Healthcare Accessibility: CALOs have enhanced healthcare access across various regions. In the Active Tista Floodplain, 89.7% of respondents reported improved healthcare access due to CALOs. Overall, 68.1% of respondents across all areas indicated positive contributions of CALOs to healthcare accessibility.

Safety and Shelter: The economic benefits of CALOs have enabled households to afford better housing conditions, enhancing safety and resilience against natural disasters. In the Active Tista Floodplain, 89.7% of respondents felt confident about their family's safety due to CALOs. Similarly, improvements in home conditions were reported across different regions, with the majority of respondents acknowledging positive changes.

Adaptive Capacity

CALOs have significantly contributed to enhancing the adaptive capacity of households:
Preparedness for Adverse Weather: Despite variations across regions, many beneficiaries felt more prepared for adverse weather conditions due to CALOs. In the Active Tista Floodplain, 79.4% of respondents disagreed with feeling more prepared, indicating room for improvement in perceived preparedness.

Income Stability: A majority of respondents (74.4%) reported that their income became more stable after starting CALOs. The Active Tista Floodplain showed the highest percentage (86.7%) of respondents reporting more stable incomes.

Adoption of New Practices: The majority of respondents indicated the adoption of new agricultural practices. In the Active Tista Floodplain, 89.7% adopted a few new types of crops or animals, reflecting proactive adaptation strategies.

Confidence in Adaptive Capacity: Across all regions, 80.9% of respondents expressed confidence in their household's ability to adapt to climate change. The Active Tista Floodplain exhibited the highest confidence level (93.9%).

Gender Roles and Empowerment

The implementation of CALOs has played a pivotal role in advancing gender roles and empowerment:

Women's Participation: Women have shown increased participation in CALOs, leading to economic benefits and improved financial independence. Their roles in leadership and decision-making have expanded, contributing to breaking down traditional gender barriers.

Economic Opportunities: CALOs have provided new livelihood opportunities for women, enhancing their income and economic participation. This economic empowerment is evident in improved financial resources and contributions to household income.

Social and Cultural Shifts: The participation of women in CALOs has led to increased community respect and trust in women, fostering a more inclusive environment. Despite these advancements, challenges related to cultural norms and societal expectations remain.

Changes in Gender Roles: CALOs have catalyzed shifts in traditional gender roles, promoting more equitable sharing of household responsibilities and increased leadership roles for women. These changes reflect a cultural transition towards gender equality.

The cross-sectional analysis of CALOs demonstrates their significant impact on enhancing resilience, economic stability, and gender empowerment among beneficiaries. By addressing specific challenges and leveraging strengths across different regions, CALOs can contribute to sustainable development and improved living conditions in climate-vulnerable areas of Bangladesh.

Context-Specific List of CALOs

This chapter examines various Climate Adaptive Livelihood Options (CALOs) tailored to Bangladesh's distinct agro-ecological regions, including the Active Tista Floodplain, Sylhet Basin, Ganges Tidal Floodplain, Young Meghna Estuarine Floodplain, and Northern and Eastern Hills. These CALOs aim to boost resilience and sustainability amidst climate change by combining traditional knowledge with modern practices. They address specific regional challenges such as flooding, soil salinity, water scarcity, and biodiversity loss, offering solutions that are socially acceptable, economically

viable, and environmentally sustainable. This approach supports sustainable livelihoods, reduces climate vulnerability, and promotes long-term environmental stewardship.

Agro-Ecological Zone Wise Proposed List of CALOs

- **Active Tista Floodplain**

Flood-resistant rice varieties: These varieties are highly accepted among local farmers due to their familiarity with rice cultivation. They offer high economic returns as rice is a staple crop and can survive submergence, reducing crop loss during floods.

Floating gardens (Hydroponics): While requiring training and community engagement, floating gardens have high economic potential through year-round vegetable production. They utilize floodwaters for cultivation, reducing land dependency and improving water management.

Duck-Fish Farming: This integrates well with existing farming practices and is highly accepted. It provides a dual-income source from both ducks and fish. Ducks control pests and fertilize fish ponds, promoting a balanced ecosystem.

- **Sylhet Basin**

Boro rice varieties resistant to flash floods: These varieties are highly accepted due to existing familiarity and offer high economic returns. They are specially bred to withstand flash floods, reducing crop losses.

Haor-based fisheries: Aligning with traditional fishing practices, this option has high acceptance and potential for sustainable fish farming, suitable for the wetland ecosystem and enhancing biodiversity.

Short-duration pulse cultivation (Lentils, Mung Beans): Requiring awareness and training, these pulses have high economic potential with short crop cycles and improve soil fertility through nitrogen fixation.

- **Ganges Tidal Floodplain**

Salt-Tolerant rice varieties: Building on existing rice farming knowledge, these varieties offer high returns due to stable market demand for rice and are specifically bred for saline conditions, improving resilience.

Brackishwater shrimp farming: A traditional practice in coastal areas, this option has high potential income through export markets and utilizes saline water, reducing the impact on freshwater resources.

Mangrove afforestation and sustainable harvesting: While requiring community involvement, this option has high potential through sustainable timber and non-timber products, enhancing coastal protection against tidal surges and improving biodiversity.

Crop rotation technology: Familiar to farmers, crop rotation practices provide diverse income streams and promote agrobiodiversity, enhancing ecosystem resilience.

Rainwater harvesting and integrated water management: This improves access to clean water, reduces dependence on external water sources, and promotes the sustainable use of local water resources.

- **Young Meghna Estuarine Floodplain**

Salt-tolerant rice varieties: These varieties build on existing knowledge and offer high economic returns due to stable market demand, improving resilience to saline conditions.

Brackishwater shrimp farming: Traditional in coastal areas, this farming method offers high potential income through export markets and utilizes saline water.

Aquaculture and horticulture integration: Integrating familiar practices, this option provides high potential returns from diversified income sources and enhances water use efficiency, supporting biodiversity.

Rainwater harvesting and integrated water management: This method improves access to clean water, reduces household and agricultural costs, and promotes sustainable water resource use.

- **Northern and Eastern Hills**

Agroforestry (Tree-crop-livestock integration): Highly accepted and aligning with traditional practices, agroforestry diversifies income through multiple products and reduces soil erosion while enhancing biodiversity.

Terrace farming for vegetables and fruits: Although requiring training and infrastructure, this method offers high potential returns through high-value crops and is suitable for hilly terrains, reducing soil erosion.

Silvopasture (combining forestry with grazing): Accepted among livestock farmers, this method diversifies income from timber and livestock and enhances soil health while providing fodder.

Eco-tourism: Developing eco-tourism can improve local infrastructure and provide a sustainable revenue source, supporting community development projects and enhancing living standards. It also contributes to forest conservation and carbon sequestration.

Waste-recycling: This adds a new economic activity to the region, reducing dependency on traditional livelihoods. It enhances the overall quality of life by maintaining clean environments and protecting local ecosystems.

The CALOs tailored to Bangladesh's diverse agro-ecological regions offer innovative solutions that enhance resilience and sustainability by addressing local challenges and leveraging regional strengths. Integrating traditional knowledge with modern practices improves social acceptance, economic viability, and environmental sustainability, contributing to the well-being and long-term resilience of climate-vulnerable communities.

Assessment of Existing CALOs

Ranking	Name of CALO	Environmental, Social, Economic Viability	Gender Impact (Changes in women's income)	Marketability	Resilience to climate change	Economic benefit	Effectiveness	Overall Score
1	Green Job (Bamboo-based Handicraft)	74	50	48	98	33	87	**65**
2	Crab Fattening	78	50	45	100	25	88	**64**
3	Watermelon Cultivation	81	33	47	100	33	89	**64**
4	Mung Bean Cultivation	81	50	52	87	25	89	**64**
5	Saline Water Fisheries	73	50	47	98	20	86	**62**
6	F-1 Calf Rearing	80	25	51	91	33	90	**62**
7	Brackishwater Fish Polyculture	78	33	48	93	20	88	**60**
8	Vermicompost	74	33	46	97	20	86	**59**
9	Maize Cultivation	77	33	49	85	25	85	**59**
10	Integrated Agriculture Farming	79	20	49	92	25	88	**59**
11	Sheep and Duck Rearing	72	33	47	93	20	84	**58**
12	Duck Rearing	76	33	48	87	20	84	**58**
13	Native Poultry Rearing	75	33	47	87	25	82	**58**
14	Sheep Rearing	81	33	47	85	17	84	**58**
15	Integrated Vegetable Cultivation	79	20	49	91	20	88	**58**
16	Pig Rearing	80	33	41	79	25	78	**56**
17	Native Chicken Rearing	76	25	46	83	17	82	**55**
18	Carp Fish Polyculture	74	33	43	76	20	76	**54**
19	Integrated Agriculture and Poultry	72	25	47	73	13	76	**51**
20	Duck & Fish Farming	73	25	46	70	13	76	**50**
21	Stress Tolerant Vegetable Cultivation	70	20	0	99	20	87	**49**
22	Sunflower Cultivation	71	50	33	14	25	47	**40**

* Source: Cross Sectional Study on CALO, DM-Watch

** Based on CALO wise weighted score

Chapter 1
Introduction

1.1 Understanding of the Assignment as per the Terms of Reference

1.1.1 Background and Contextual Understanding

The Local Government Initiative on Climate Change (LoGIC) represents a significant response to climate change challenges in Bangladesh, aiming to empower vulnerable communities and local governments in climate change adaptation. Developed initially in 2015 with the support of the European Union, and SIDA, LoGIC has evolved into a multi-donor initiative, integrating efforts from various international agencies including UNDP and UNCDF, and executed by the Local Government Division of Bangladesh's Ministry of Local Government, Rural Development and Cooperatives (MoLGRD&C) .

Bangladesh's vulnerability to climate change is profound. Ranked as one of the top countries affected by climate-related disasters, the nation confronts changes in rainfall patterns, rising temperatures, and frequent extreme weather events like cyclones and floods. These climatic challenges have led to increased salinity in water resources and soil, significantly impacting the economy and exacerbating poverty and vulnerability.

Recognizing the severity of climate change, the Bangladesh government has mainstreamed related concerns into its national development policies. The national climate change strategy and action plan (BCCSAP 2009) guide governmental efforts. However, there is an acknowledged gap at the local level, where Local Government Institutions (LGIs) often struggle to fully harness local community potential in climate adaptation planning and execution. This gap is where LoGIC aims to intervene, enhancing local capacity for sustainable development and climate resilience.

LoGIC is designed to support around 500,000 of the most vulnerable households in various districts of Bangladesh. Its approach encompasses building capacity, awareness, and empowerment for both vulnerable communities and local governments. The initiative also emphasizes the development of local climate adaptation plans and the provision of grants for community-based adaptation work. This comprehensive approach aims to reduce poverty and vulnerability by integrating high-quality accountability and participation at all levels of the project.

The project, with a total duration of 105 months (July 2016-June 2025), is managed by a Project Steering Committee comprising various ministries and development partners. UNDP and UNCDF jointly manage a Project Management Unit to support the Local Government Division. The project's total budget is estimated at around US $45.48 million, with contributions from different international donors.

1.1.2 Assignment's Objectives

Community Resilience Fund (CRF) was established to provide support to the most vulnerable women to climate change in selected climate hotspots of the country. Over the period, the CRF fund was used to implement Climate Adaptive livelihood Options (CALO). Climate Adaptive Livelihood Options (CALO) refer to the strategies and capacities that enable individuals and

communities to sustain their livelihoods despite environmental changes and shocks. Unlike traditional livelihoods, which are often narrowly defined as income or employment generation, CALO encompasses a broader understanding of well-being that includes access to shelter, food, health, mobility, recreation, water and sanitation, and social life. This broader perspective is particularly important in traditional societies where aspects of well-being do not solely rely on monetary transactions. The main objective of the assignment was to assess the role of the LoGIC CRF fund and selected CALOs in promoting climate-resilient livelihood options of the selected beneficiary households.

The specific objectives are:

- To determine the environmental, social and economic viability of Climate Adaptive Livelihood Options (CALOs) in practice in various contexts, including coastal areas, hill tracts, salinity-prone areas, and others.
- To conduct a technical analysis of the existing CALOs, evaluating their continued relevance in the context of climate change. Identify emerging innovations that have the potential to replace outdated elements and recommend new CALOs tailored to diverse climatic conditions in the country, particularly those suitable for the benefit of women.
- To present a concise selection of CALOs derived from on-site assessments that have the potential for scalable implementation in cooperative structures. Cross-sectional analysis of CALOs promoted by LoGIC, considering climate hotspots, geographical conditions, socio-economic context of beneficiaries, gender, adaptive capacity and individual vs. group approach.
- To assess the extent to which the selection, planning and implementation of the CRF-supported climate-adaptive livelihood options were effective in adapting to climate change.
- To assess the role of the Community Mobilization Facilitators (CMFs), Upazila Line Departments and local resource persons in the success of the CRF-supported climate-adaptive livelihood options.
- To assess the impact of CALOs on household well-being, including income, savings, food, water, health, shelter, safety, and the local economy such as agriculture, fisheries, livestock, poultry, small trades, MSMEs, employment, and markets.
- To know the level of understanding of the climate adaptive livelihoods among the CRF beneficiaries of LoGIC project.
- To evaluate the gender-specific impact of CALOs and understand how they have influenced the transformation of lives and gender roles within communities.
- To assess the marketability of CALOs and identify potential stakeholders for engagement and support.

1.1.3 Geographic Coverage

The geographical coverage of this study encompasses 11 districts, which include diverse and climatically sensitive regions of Bangladesh. This wide coverage ensures a comprehensive understanding of the varied impacts of climate change and the effectiveness of CALOs across different ecological zones.

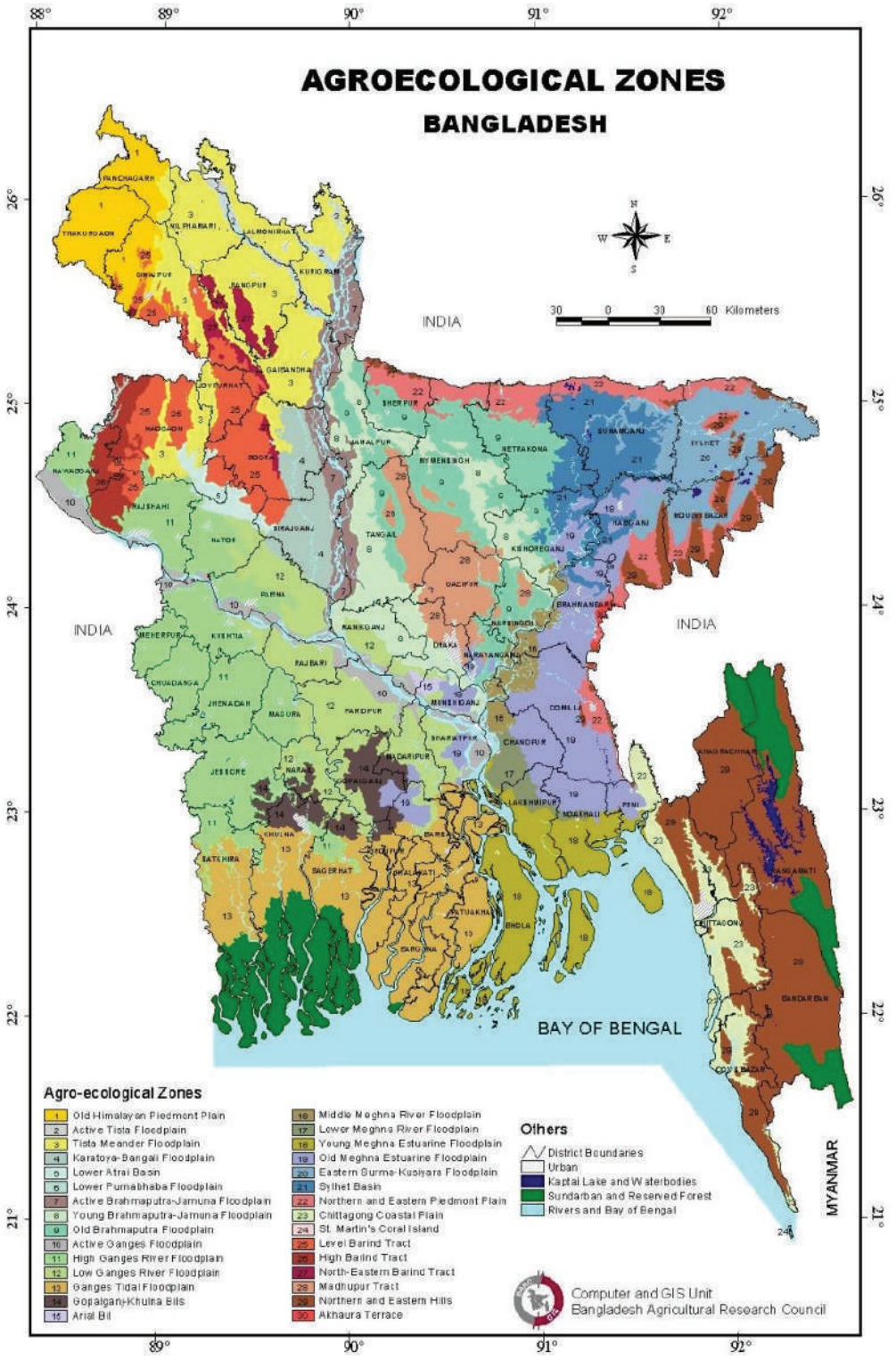


Figure1: Agro - ecological zones of Bangladesh (Source: Ministry of Agriculture,Bangladesh.)

Below are the names of the 11 districts in the study area, selected based on the agro-ecological zones of Bangladesh.

Table 1: Study area

Agro-ecological zone	District
Active Tista Floodplain	Kurigram
Sylhet Basin	Sunamganj
Ganges Tidal Floodplain	Khulna
	Bagerhat
	Barguna
	Patuakhali
Young Meghna Estuarine Floodplain	Bhola
	Noakhali
	Chattogram
Northern and Eastern Hills	Rangamati
	Bandarban

1.2 Strategies for approaching project areas of Climate Adaptive Livelihood Options (CALOs)

In regions like Kurigram, Sunamganj, Khulna, Bagerhat, Barguna, Patuakhali, and Bhola where Climate Adaptive Livelihood Options (CALOs) were implemented, a mixed-method approach was used to evaluate CALOs' effectiveness and adaptability, while for upcoming areas like Rangamati and Bandarban, Noakhali, and Chattogram the focus shifted to secondary reviews and qualitative analyses to assess CALOs' contextual fit and potential.

Chapter 2
Methodology

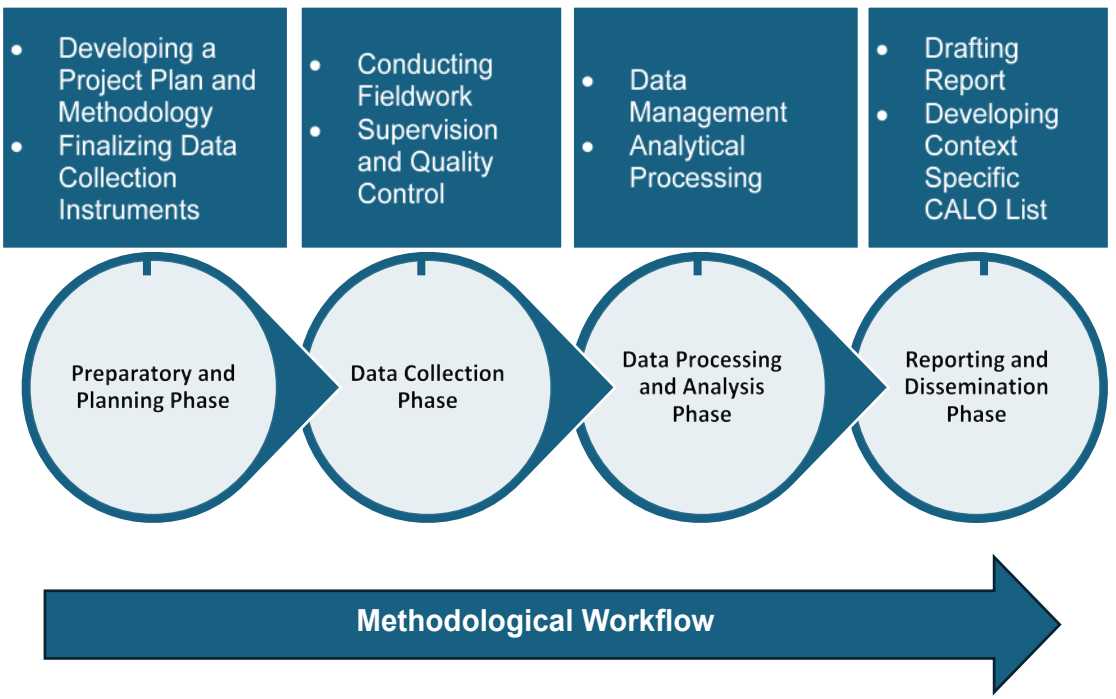
2.1 Methodological Workflow

DM WATCH structured the study into a methodological workflow that blended quantitative and qualitative research methods.

Phase 1: Preparatory and Planning Phase

Developing a Project Plan and Methodology: The study framework was designed to define research questions, identify data sources, and choose suitable data collection methods to meet project objectives.

Finalizing Data Collection Instruments: Tools such as questionnaires and interview guides were developed and refined to capture diverse data across different districts, employing culturally sensitive and locally appropriate methodologies.



Conducting Fieldwork: Surveys, interviews, and focus groups were conducted across targeted districts using stratified sampling and mixed methods.

Supervision and Quality Control: The data collection process was continuously monitored to ensure data integrity, employing real time monitoring techniques and debriefing sessions.

Phase 3: Data Processing and Analysis Phase

Data Management: The collected data was organized, coded, and cleaned for analysis, using advanced data management software.

Analytical Processing: Data was analyzed using statistical and thematic analysis techniques to extract insights relevant to the study's objectives.

Phase 4: Reporting and Dissemination Phase

Drafting Report: A detailed report was compiled, integrating quantitative and qualitative findings to present a holistic view of the study outcomes.

Developing Context Specific CALO List: A tailored list of CALOs was formulated based on climate vulnerabilities and socioeconomic contexts, incorporating feedback from local stakeholders.

2.2 Data Collection

The study employed a mixed-method approach for collecting data from secondary and primary sources. Both quantitative and qualitative data were collected from the primary sources.

2.2.1 Secondary Documents Review

DM WATCH conducted an extensive review of secondary documents to establish context, assess the current research state, and identify knowledge gaps for the LoGIC project analysis.

2.2.2 Primary Data Collection

Quantitative Survey Methodology

Respondents:

Beneficiaries of CALOs were identified from the project's list, focusing on those involved with CALOs supported by the Community Resilience Fund (CRF).

Sampling Approach:

Stratified random sampling was used to select survey respondents from the beneficiary group across four agroecological zones, targeting one district per CALO and up to three Upazilas per district for detailed interviews.

Respondent Selection and Outreach:

Beneficiaries were randomly chosen from a list provided by UNDP to minimize bias and ensure diverse experiences were represented.

Qualitative Data Collection

The qualitative data complemented the quantitative by offering depth and context, capturing nuanced perspectives of stakeholders on the effectiveness and impact of CALOs in the LoGIC project.

Purposive Sampling:

Appropriate samples/respondents were selected through purposive sampling based on the study's needs.

Key Informant Interviews (KIIs):

In-depth interviews were conducted with experts on CALOs, including project staff, local officials, community leaders, and civil society members.

Focus Group Discussions (FGDs):

Group discussions with vulnerable communities in extension areas explored their vulnerabilities, capacities, and perspectives on CALOs, including mixed beneficiaries, women, and youth aged 16 to 30.

Case Studies:

The case study component analyzed 22 CRF groups across various CALOs and agroecological zones to understand their business viability, scalability, and sustainability.

2.2.3 Sampling Strategies

Quantitative Sampling Strategies for the Household Survey

Quantitative data for the assessment was collected from CRF beneficiaries using structured questionnaires prepared by the study team.

Probability sampling strategy ("Stratified Random Sampling") was used for selecting the households. To get the statistically significant sample size, we used Cochran's formula and selected the parameters.

$$n \quad \frac{P\ 1-P\ (Z\quad)^2}{(P\quad p\ ^2} \quad \text{..... (Equation 1)}$$

Where,

P = Proportion to be estimated = 50%, which gives statistically significant sample size;
P – p = Margin of error;
$Z_{95\%}$ = Z-value at the 95% confidence level;
n = Size of sample

Quantitative Sample Size for Beneficiaries of CALOs

Sampling Frame and Strategy

- Identification of Beneficiaries: Utilize the UNDP LoGIC team's list of beneficiaries as the primary sampling frame.
- Stratified Random Sampling: Given the diversity of the beneficiaries in terms of geography, type of livelihood activities, and socio-economic backgrounds, a stratified random sampling approach was used. The stratification was based on:
    i. Geographic location (across 7 districts).
    ii. Type of CALO received (e.g., agriculture, fisheries, small trades).

Determining Sample Size: 58449 households

- Total Population Reference: 58449 households across the 7 districts..
- Sample Size Calculation: The initial sample size calculated using the formula (equation 1) was 382. To maintain statistical rigor for comparative analysis within CALOs, and in accordance with the central limit theorem, the sample size was increased to 956. Finally, 1011 samples were collected.
- The districts with the highest beneficiary concentration for each CALO within each agro-ecological zone were pinpointed.

The distribution of sample CRF beneficiaries across districts is given below -

Table 2 : Sample distribution of CRF beneficiaries (District Wise) on Livelihood Options

SL	Climate Adaptive Livelihoods Option	Zone 13 (Ganges Tidal Floodplain)				Zone 18 (Young Meghna Estuarine Floodplain)	Zone 2 (Active Tista Floodplain)	Zone 21 (Sylhet Basin)	
		Khulna	Bagerhat	Barguna	Patuakhali	Bhola	Kurigram	Sunamganj	Total
1	Brackish water Fish Polyculture		24			24			48
2	Duck and Fish farming	31				32			63
3	Carp fish polyculture				25	24			49
4	Sunflower cultivation			24					24
5	Duck rearing			24				24	48
6	Integrated Agriculture and Poultry	24				24		25	73
7	Sheep and Duck rearing	24						25	49
8	Sheep rearing	24					24	24	72
9	Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber ..)	24				23	24		71
10	Crab fattening	24							24
11	Integrated vegetable cultivation	24				24	15		63
12	Integrated agriculture farming	24				24	24	25	97
13	Pig rearing	24							24
14	Maize Cultivation		24				24		48
15	Mung bean cultivation			24					24
16	Vermicompost			23			6		29
17	Saline water fisheries	24							24
18	Native Poultry Rearing		24						24
19	Green Job (Bamboo-based Handicraft)		16						16
20	Watermelon cultivation	24							24
21	Native chicken		26			24	24	19	93
22	F-1 Calf Rearing						24		24
Total		271	114	95	25	199	165	142	1011

Qualitative Sampling strategy and distribution

The qualitative study involved a total of 123 participants, including 82 individuals for Key Informant Interviews, 19 for Focus Group Discussions, and 22 participants for detailed case studies.

Table 3: Participants of Key Informant Interview

Level	Respondent	Number
National level KII	Fisheries Research Institute (FRI)	1
	Livestock Research Institute	1
Sub Total		**2**
Local level KII	Upazila Extension/Line Departments Officials Offices (Agri, Livestock and Fisheries)	30
	UZP women affairs office	5
	Upazila Cooperative Office	5
	Community Mobilization Facilitators (CMFs)	9
	Market stakeholder representatives from different CALOs	22
Sub Total		**71**
Project	National Project Director - LoGIC	1
	LoGIC district coordinators	9
Sub Total		**10**
FGD	CRF Beneficiaries of the project area	7
	Targeted beneficiaries of CALOs from the LoGIC extension area (Mixed group)	4
	Vulnerable Groups (Women) from the LoGIC extension area	4
	Vulnerable Groups (Youth-mixed) – Aged (16-30) from the LoGIC extension area	4
Sub Total		**19**
Case Studies	CRF groups	22
Sub Total		**22**
Grand Total		**124**

2.2.4 Analytical model

The study used both secondary and primary data, with qualitative tools for content analysis and quantitative surveys for descriptive statistics. Data were analyzed using an analytical framework, with qualitative information from Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs). Descriptive statistics described data characteristics, while aggregation and disaggregation methods were applied to project components. Comparative analysis explored patterns among qualitative factors, and content analysis was used for qualitative data, incorporating gender-based and socio-economic segregation into the descriptive analysis.

Descriptive Statistics

Quantitative data from questionnaire interviews were analyzed using SPSS for detailed descriptive and cross-tabular analyses, while MS Excel was used for graph production. Most questionnaires featured close-ended questions recorded numerically to facilitate accurate statistical analysis.

The Sustainable Livelihoods Approach

The sustainable livelihood approach was used to assess the environmental, social, and economic viability of CALOs, guiding the formulation of development activities based on insights into how the poor manage their lives and the role of policies and institutions.

It helped in formulating development activities that are:

- People-centered
- Responsive and participatory
- Multilevel
- Conducted in partnership with the public and private sectors.
- Dynamic
- Sustainable

The sustainable livelihoods approach facilitates the identification of practical priorities for actions that are based on the views and interests of those concerned but they are not a panacea.

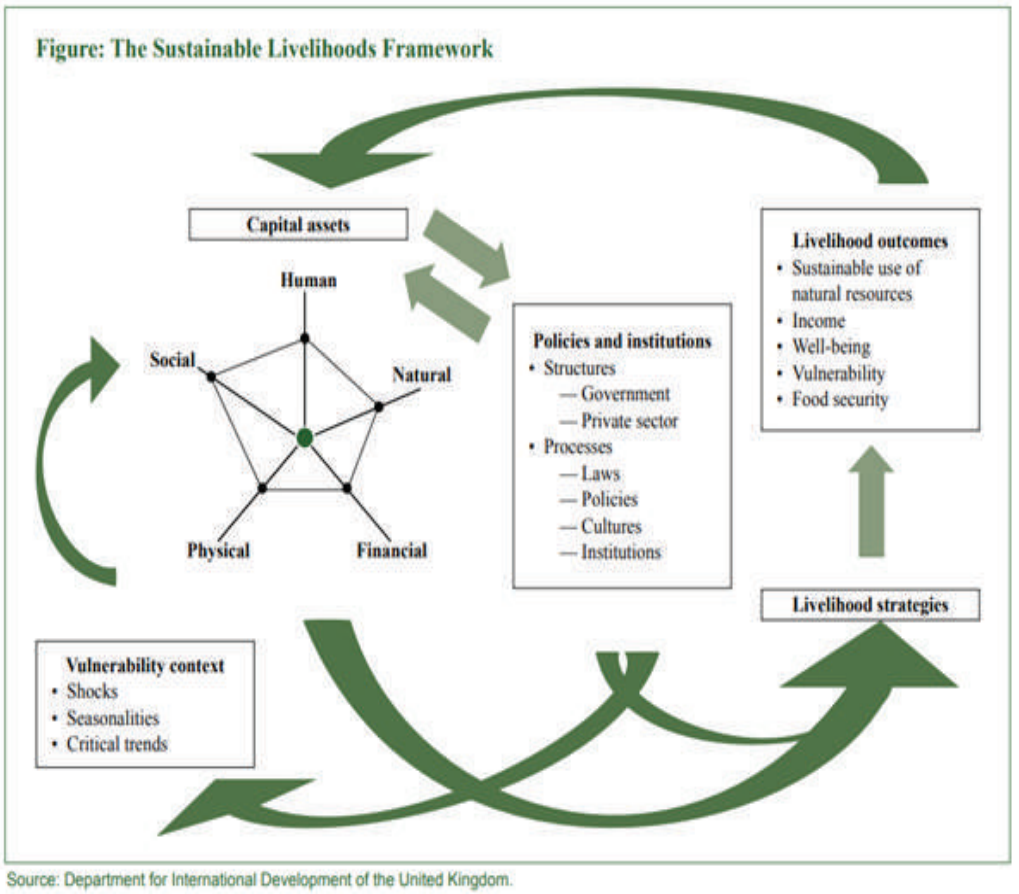


Figure 2; The Sustainable Livelihoods Framework

Capital Assets

The sustainable livelihoods framework organizes factors affecting livelihood opportunities, highlighting how different households' access to livelihood assets influences their choices and trade-offs,

Comprise:

- **Human capital:** e.g., health, nutrition, education, knowledge and skills, capacity to work, capacity to adapt.
- **Social capital:** e.g., networks and connections (patronage, neighborhoods, kinship), relations of trust and mutual understanding and support, formal and informal groups, shared values and behaviors, common rules and sanctions, collective representation, mechanisms for participation in decision-making, leadership
- **Natural capital:** e.g., land and produce, water and aquatic resources, trees and forest products, wildlife, wild foods and fibers, biodiversity, environmental services.

[2]https://www.adb.org/sites/default/files/publication/27638/sustainable-livelihoods-approach.pdf

- **Physical capital:** e.g., infrastructure (transport, roads, vehicles, secure shelter and buildings, water supply and sanitation, energy, communications), tools and technology (tools and equipment for production, seed, fertilizer, pesticides, traditional technology)
- **Financial capital**[3] e.g., savings, credit and debt (formal, informal), remittances, pensions, wages.

Vulnerability Context

Vulnerability refers to the insecurity in well-being experienced by individuals, households, and communities due to external environmental changes, capturing the dynamics of change better than poverty measurements. It has two aspects: external shocks and trends, and internal defenselessness stemming from a lack of coping ability and resources.

- **shocks:** e.g., conflict, illnesses, floods, storms, droughts, pests, diseases
- **seasonality's**: e.g., prices, and employment opportunities
- **critical trends:** e.g., demographic, environmental, economic, governance, and technological trends.

The sustainable livelihood approach assessed the environmental, social, and economic viability of CALOs, emphasizing the importance of policies, institutions, and processes in shaping effective, pro-poor strategies and transforming resource access for vulnerable populations.

Livelihood Strategies and Outcomes

Policies and Institutions

The study showed that while livelihood strategies aim to increase income, improve well-being, and promote sustainable resource use, they can also create conflicts between short-term and long-term goals or among community members.

Implications

The sustainable livelihoods approach promoted a shift from traditional problem-solving models to dynamic, process-oriented strategies, emphasizing the need for context-specific policies and a comprehensive understanding of institutional frameworks.

Benefit-Cost Analysis

First of all, relevant costs will be identified and listed associated with the CALO. These include operating and maintenance costs, and any other expenses. Then the benefits, i.e., revenue-related data, will be collected. Finally, the cost-benefit ratio has been calculated by dividing the total benefits by the total costs.

Benefit-Cost Ratio= (Total Benefit/Total Cost)

A ratio greater than 1 indicates that the benefits outweigh the costs.

PESTEL Framework[3]

The PESTEL framework, which stands for Political, Economic, Social, Technological, Environmental, and Legal factors, will be used as a tool for analyzing the marketability of different livelihood options. It's an extension of the PEST analysis, and it provides a comprehensive macro-environmental framework to assess how various external factors might impact the viability and market potential of various livelihood options. Here's how each element can apply to marketability analysis:

[3] Financial capital tends to be the least available livelihood asset of the poor. Indeed, it is because the poor lack it that the other types of capital are so important to them.

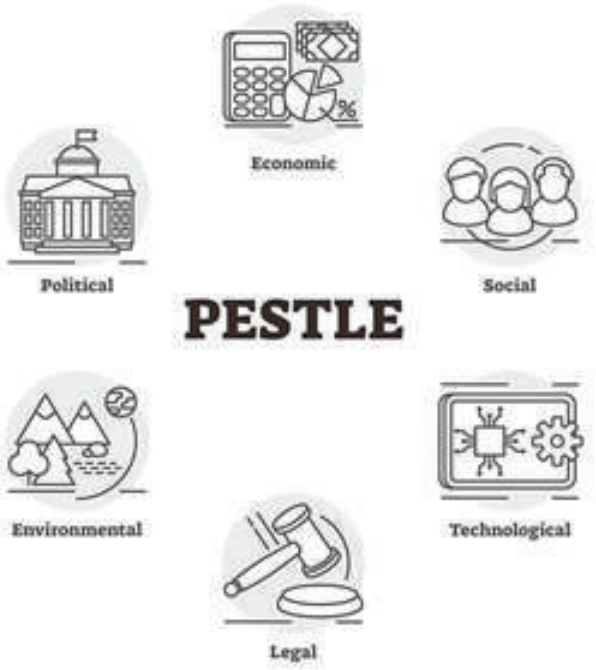


Figure 1: PESTEL Framework for marketability and scalability analysis.

Political (P): Examines the impact of political factors such as government policies, trade restrictions, and political stability on livelihood options. It considers how changes in these areas might affect market access and profitability.

Economic (E): Assesses economic conditions that affect the marketability of livelihood options, such as inflation rates, economic growth, exchange rates, and economic cycles. It also looks at consumer spending habits and the availability of credit.

Social (S): Looks at social trends, population demographics, and cultural norms that can influence consumer preferences and demand for certain products or services.

Technological (T): Considers how technological advancements can create new livelihood options or disrupt existing ones. It also examines the role of technology in improving production efficiency and access to markets.

Environmental (E): Evaluates how environmental factors, such as climate change, natural resource availability, and ecological regulations, impact the sustainability and marketability of livelihood options.

By using the PESTEL framework, it has been possible to identify which livelihood options were most likely to succeed in the market and which might face challenges. This analysis helped shape strategies for market entry, product development, risk management, and long-term planning. It proved particularly useful for livelihood options sensitive to external factors, such as agriculture-based livelihoods impacted by environmental conditions or technology-based livelihoods influenced by rapid innovation.

[4]https://pestleanalysis.com/what-is-pestle-analysis/

Content Analysis

The qualitative data was analyzed using content analysis. Initial focus areas for Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) were identified, followed by four key steps:

- **Preliminary Analysis:** Collaborative initial review with Research Assistants to understand data and identify early themes.
- **Thematic Coding:** Systematic categorization of data into themes related to reasons, causes, and consequences.
- **Compilation of Data:** Grouping of similar findings to draw deeper insights and identify overarching themes.
- **Selection of Issues and Quotations:** Compilation of key observations and quotations to provide context and support findings.

Gender Analysis

Gender analysis, a critical component of socio-economic analysis, has been utilized to identify and explain the gaps between men and women across different contexts, focusing on gender norms and power relations. The evaluation has incorporated a gender equality perspective and a rights-based approach to assess the design, implementation, and outcomes of the project. This approach has included:

- Combining qualitative and quantitative sampling methods.
- Forming evaluation teams of males and females, suitable for the cultural context and data collection.
- Ensuring that samples comprise both genders, corresponding to the evaluation questions.
- Integrating relevant evaluation questions.

A gender analysis module prepared by USAID has been adopted to ensure that gender equality and the empowerment of women are thoroughly addressed throughout the program's lifecycle.

Triangulation of Qualitative and Quantitative Data

Triangulation has been employed, combining quantitative and qualitative methodologies to strengthen the research design. Quantitative data from surveys have been triangulated with qualitative data from various stakeholders and secondary documents reviewed. Methodological triangulation has helped ensure objective analysis, prevent bias in research results, and identify gaps or inconsistencies.

Chapter 3
Environmental, social, economic viability and gender impact analysis of CALOs

The findings from the data collected through quantitative and qualitative interviews with CALO beneficiaries are discussed in the subsequent chapters. This chapter begins with a focus on the demographic profile of the CALO beneficiaries. It then discusses the understanding of CALO beneficiaries about climate change and climate adaptive livelihood. Finally, the social, economic and environmental viability of the CALOs is assessed.

3.1 Profile of the Respondents

The findings from Table 1 show that the surveyed population are mostly females, constituting 98.4% of respondents, compared to only 1.6% males. The age distribution of the respondents indicates that the majority of the CALO beneficiaries fall within the age group of 31 to 40 years, accounting for 33.8% of the sample, followed closely by the 41 to 50 years age group at 28.4%. Regarding engagement with income-earning activities, 61% of the beneficiaries are involved in other income sources aside from their CALO activities. Those who were involved in a secondary profession were asked about their occupation. The largest segment was found to be engaged in livestock (42.6%) and significant portions as housewives (17.7%) and day laborers (16.2%). Most households consist of 4 to 6 members (64.5%). Finally, the duration of CALO involvement is most commonly between 25 to 36 months (39.6%), suggesting a considerable period of engagement among the majority.

Table 4: *Socio-demographic profile of the study respondents (Response in %, N=1011)*

Variables	Percentage
Sex of the respondent	
Male	1.6
Female	98.4
Age	
21 to 30 years	21.1
31 to 40 years	33.8
41 to 50 years	28.4
51 to 60 years	12.8
61 to above	4
Engagement with other income earning activities except CALO	
Yes	61
No	39
Occupation (N=617)	
Livestock	42.6
Merchant	3.2
Skilled worker	4.2

Day labor	16.2
Agricultural la bor	8.4
Housewife	17.7
Others (Unskilled worker, driver, employee, teacher, handicraft, begging, chicken, domestic, fisherman, domestic worker, rice, tailor, homestead vegetable)	7.6
Household size	
1 to 3 household members	23.3
4 to 6 household membe rs	64.5
7 to above household members	12.2
CALO involvement in months	
3 to 24 months	10.7
25 to 36 months	39.6
37 to 48 months	25
49 to above	24.7

The income distribution from CALO activities among the beneficiaries shows a diverse range of earnings. The largest segment (22.7%) earns between 1,001 to 2,000 Taka, followed by those earning 2,001 to 3,000 Taka (17.4%) and 85 to 500 Taka (19.6%). Notably, 12.7% of the beneficiaries have not earned any income from CALO activities. In terms of overall income from all sources, the data indicates that a substantial number of beneficiaries, 38.1%, have total earnings ranging from 10,001 to 15,000 Taka. The expenditure patterns show that a majority of the beneficiaries spend between 5,001 to 10,000 Taka (37.8%) and 10,001 to 15,000 Taka (37.9%), which aligns closely with their most common income brackets.

Table 5: *Household income and expenditure pattern of CALO beneficiaries (Response in %, N=1011)*

Variable	Percentage
Income from CALO	
No income	12.7
85 to 500	19.6
501 to 1000	14.8
1001 to 2000	22.7
2001 to 3000	17.4
3001 to above	12.8
Income from all sources	
Below 7000	7.9
7000 to 10000	22.4
10001 to 15000	38.1
15001 to 20000	21.2
20001 to above	10.5
Expenditure	
1000 to 5000	7
5001 to 10000	37.8
10001 to 15000	37.9
15001 to above	17.3

The below table presents the distribution of the study population's engagement in various CALO activities. The highest percentage of the population is engaged in 'Integrated Agriculture Farming' and 'Native Chicken Rearing,' with 9.6% and 9.2% participation, respectively. Similarly, 'Stress Tolerant Vegetable', 'Sheep Rearing' and 'Integrated Agriculture and Poultry' each account for over 7% of the beneficiaries, reflecting notable involvement in livestock management and combined farming systems. Besides, less than 3% of the beneficiaries are engaged with CALO activities like 'Green Job (Bamboo-based Handicraft)', specific types of cultivation, such as 'Sunflower Cultivation' and 'Mung Bean Cultivation'.

Table 6: *Distribution of study population by CALO engagement (Response in %, N=1011)*

Name of the CALO	Percentage
Crab fattening	2.4
Carp fish polyculture	4.8
Sheep rearing	7.1
Pig rearing	2.4
Integrated Agriculture and Poultry	7.2
Duck and Fish farming	6.2
Integrated agriculture farming	9.6
Green Job (Bamboo-based Handicraft)	1.6
Duck rearing	4.7
Maize Cultivation	4.7
Integrated vegetable cultivation	6.2
Mung bean cultivation	2.4
Watermelon cultivation	2.4
Vermicompost	2.9
Saline water fisheries	2.4
Sheep and Duck rearing	4.8
Brackish water Fish Polyculture	4.7
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	7
Sunflower cultivation	2.4
Native Poultry Rearing	2.4
Native Chicken Rearing	9.2
F-1 Calf Rearing	2.4

Level of understanding of the climate adaptive livelihoods among the CRF beneficiaries

The understanding of the climate adaptive livelihoods among the CRF beneficiaries was assessed in the study to have an idea about the awareness of CALO among the respondents.

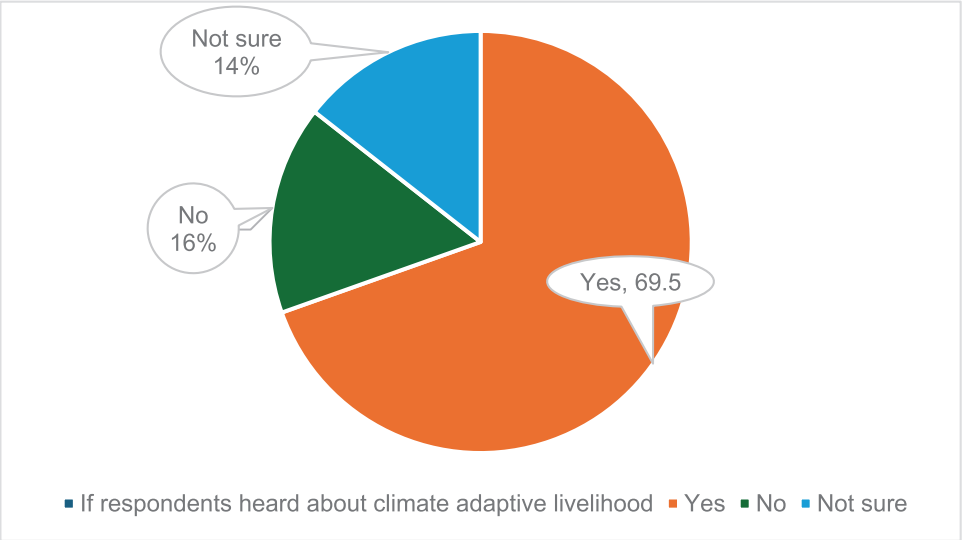


Figure 4: *If respondents heard about climate adaptive livelihood (Response in %, N=1011)*

In order to assess respondent's understanding on climate adaptive livelihoods, the CRF beneficiaries were asked if they have heard about the term "climate adaptive livelihoods". The findings indicate that a significant majority of the respondents, 69.5%, are aware of climate adaptive livelihoods. However, there remains a notable portion of the population, 16%, who have not heard about these livelihood strategies, and 14.4% who are unsure, revealing gaps in awareness.

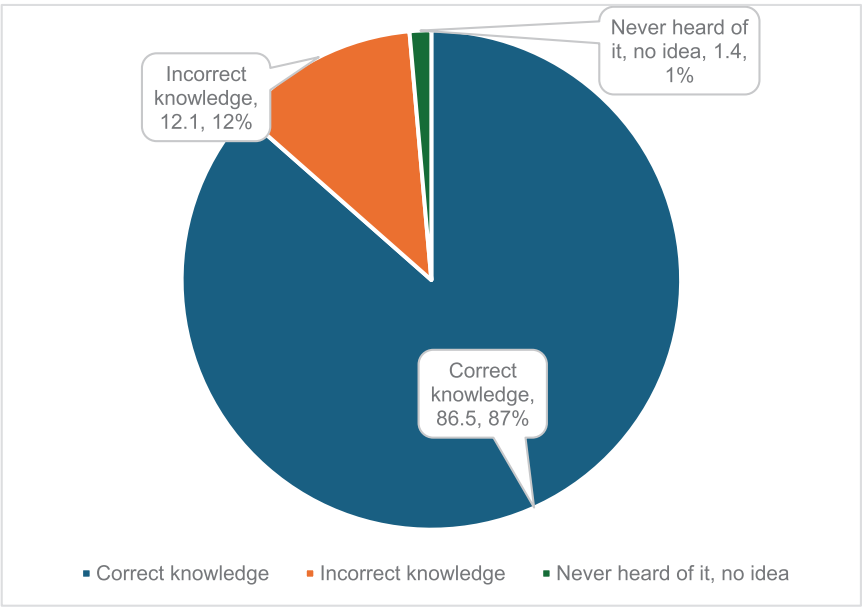


Figure 5: *Knowledge on climate adaptive livelihood (Response in %, N=703)*

Those who have heard about climate adaptive livelihood, were further asked "what is climate adaptive livelihood"? The response options included one correct answer, and 4 incorrect answers. The findings show that 86.5% possess correct knowledge about climate adaptive livelihoods, indicating a high level of understanding among the surveyed group. However, 12.1% of the respondents have incorrect knowledge about these livelihood strategies, highlighting a segment of the population with misconceptions or gaps in understanding that could potentially hinder effective adaptation efforts. A very small proportion, 1.4%, have never heard of climate adaptive livelihoods or have no idea about them.

Table 7: *Respondent's perception and level of confidence regarding climate adaptive livelihood (Response in %, N=1011)*

Response	Percentage
Respondent's perception on importance of adopting climate adaptive livelihood	
Extremely important	12.2
Very important	60.3
Moderately important	24.2
Slightly important	3.1
Not at all important	0.2
Beneficiary's level of confidence in their understanding of climate adaptive livelihood	
Very confident	8.5
Somewhat confident	73.2
Neutral	13.2
Somewhat unconfident	4.6
Very unconfident	0.5
Beneficiary's level of confidence in their understanding of necessary steps to take to adapt livelihood to climate change	
Very confident	10.3
Somewhat confident	72.6
Neutral	12.3
Somewhat unconfident	4.3
Very unconfident	0.6
Beneficiaries can identify strategies to adapt farming practices to mitigate the effect of climate change	
Strongly Disagree	0.7
Disagree	7.8
Neutral	30.3
Agree	61
Strongly agree	0.2

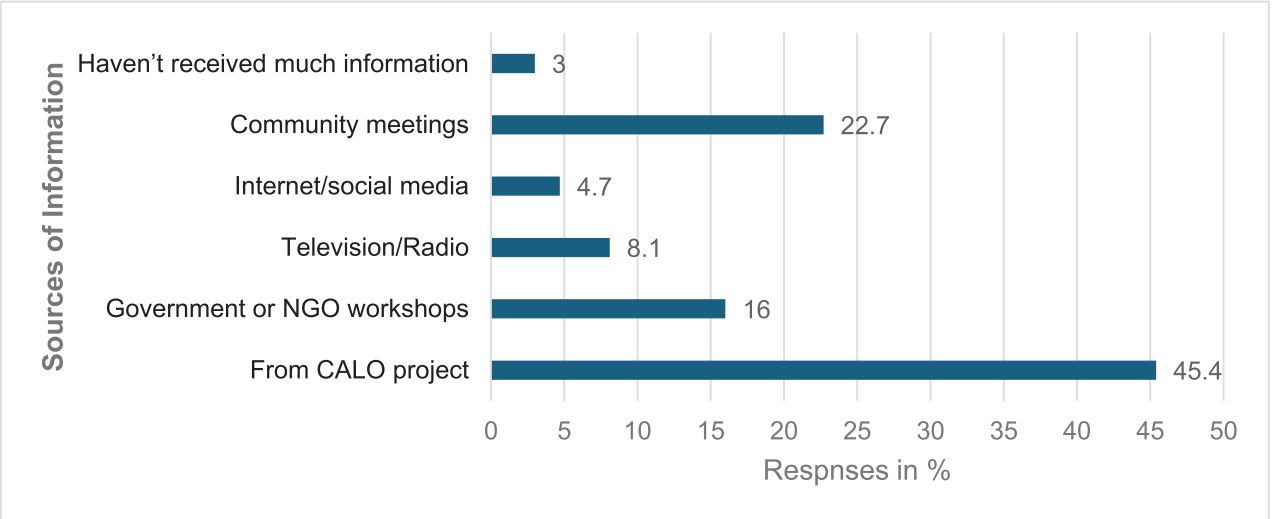


Figure 6: Source of information on climate adaptive livelihood (Response in %, multiple response, N=1011)

Respondent's understanding and level of confidence were further examined with some statements. The findings reveal a strong acknowledgment among beneficiaries about the importance of adopting climate adaptive livelihoods, with 60.3% deeming it "Very important" and 12.2% considering it "Extremely important." This demonstrates a substantial recognition of the need for climate-resilient practices. In terms of confidence, a significant majority feels assured in their understanding of climate adaptive livelihoods, with 73.2% feeling "Somewhat confident" and 8.5% "Very confident." About identifying the necessary steps to adapt the livelihoods to climate change, a similar pattern emerges, with 72.6% "Somewhat confident" and 10.3% "Very confident." Despite this, there is a noted uncertainty or ambivalence about identifying specific adaptation strategies, as 30.3% are not sure if they can identify strategies required to adapt farming practices to mitigate the effect of climate change.

In conclusion, the findings reveal a generally positive level of awareness and confidence regarding climate adaptation strategies. A significant majority of 69.5% of respondents are aware of climate adaptive livelihoods, and among those who are aware, a high proportion of 86.5% have correct knowledge about climate adaptive livelihoods. This indicates a solid foundational understanding among beneficiaries, which is crucial for implementing effective climate adaptation strategies. Besides, perceptions of the importance of adopting climate adaptive livelihoods are notably high, with 72.5% of respondents considering it either very or extremely important. This suggests a strong recognition among beneficiaries of the need for resilience in the face of climate challenges. Confidence levels among respondents about their understanding of climate adaptive livelihoods and the necessary steps to adapt are also high, with the majority feeling at least somewhat confident. However, there remains a significant portion of 30.3% who are neutral about their ability to identify specific strategies for adapting farming practices to mitigate climate change effects. Overall, while there is a commendable level of awareness and understanding among the beneficiaries, the data also highlights areas for improvement, particularly in ensuring that all beneficiaries are as informed and confident as possible about the specifics of adapting to climate challenges.

3.2 CALO wise Environmental, Social, Economic viability analysis

3.2.1 The Overview

The CALO-wise analysis using the sustainable livelihood framework evaluates the performance of various Climate Adaptive Livelihood Options (CALOs) across physical, social, natural, human, and financial capitals. This analysis covers specific geographical contexts—Zone 13 (Ganges Tidal Floodplain), Zone 18 (Young Meghna Estuarine Floodplain), Zone 2 (Active Tista Floodplain), and Zone 21 (Sylhet Basin)—revealing strengths and weaknesses of each CALO and offering insights into their overall viability.

Physical Capital

Most CALOs excel in physical capital, with scores typically between 75 and 100, indicating strong infrastructure and resources. Watermelon cultivation achieves a perfect score of 100, showcasing exceptional infrastructure. Other high performers include Mung Bean cultivation (97), Native Chicken Rearing (95), and Integrated Vegetable cultivation (94), highlighting their well-established physical infrastructure crucial for sustainability and productivity.

Social Capital

Social capital scores vary, with most CALOs ranging from 64 to 83. High scores, like F-1 Calf Rearing (92) and Crab Fattening (82), reflect strong community support and cooperation. In contrast, Integrated Agriculture scores lower at 64, indicating a need for better community engagement. Overall, while community support is generally strong, there is room for improvement in enhancing social networks and collective action, especially in regions with lower scores.

Natural Capital

Natural capital scores range from 62 to 77, reflecting the varying environmental conditions and resource availability for each CALO. Higher scores, like those for Crab Fattening (75) and Integrated Agriculture (72), indicate favorable environmental conditions. In contrast, CALOs such as Duck & Fish Farming (62) and Brackish Water Fish Polyculture (66) face environmental challenges like water quality and habitat suitability. Addressing these gaps is essential for enhancing the environmental sustainability of these livelihood options.

Human Capital

Human capital scores range from 60 to 80, with higher scores like Green Job (80) and Crab Fattening (76) reflecting strong skills and health among participants. Lower scores, such as those for Sheep and Duck Rearing (60) and Pig Rearing (65), indicate a need for improved training and healthcare. Investing in human capital is crucial for enhancing the performance and sustainability of these livelihood options.

Financial Capital

Financial capital scores range from 61 to 83, with higher scores like those for Integrated Agriculture and Green Job (both 83) indicating robust financial support and access to resources. In contrast, lower scores for Sunflower Cultivation (61) and Duck & Fish Farming (67) reveal financial constraints that could impede economic stability and growth. Enhancing financial access and support is essential for improving the economic viability of these livelihood options.

Overall, the table reveals strong physical infrastructure, community support, and financial mechanisms for CALOs, but also highlights weaknesses in environmental challenges, human capital, and financial constraints, requiring targeted interventions to address these gaps.

Table 8: *CALO Wise Livelihood Capital Asset Score, (Response in %)*

CALO	Physical Capital	Social Capital	Natural Capital	Human Capital	Financial Capital	Geographic Coverage
Brackish water Fish Polyculture	90	80	66	77	78	Zone 13, 18
Carp Polyculture	90	74	67	66	75	Zone 13, 18, 21
Crab Fattening	82	82	75	76	76	Zone 13
Duck & Fish Farming	86	82	62	66	67	Zone 13, 21
Duck Rearing	89	80	73	71	69	Zone 13, 21
F-1 Calf Rearing	88	92	82	64	76	Zone 2
Green Job ((Bamboo-based Handicraft)	75	70	63	80	83	Zone 13
Integrated Agriculture & Poultry	86	64	72	64	73	Zone 13, 18, 21
Integrated Agriculture	90	78	75	69	83	Zone 13, 18, 2, 21
Integrated vegetable cultivation	94	81	77	68	75	Zone 13, 18, 2
Maize cultivation	92	79	70	70	76	Zone 13, 2
Mung Bean cultivation	97	83	71	71	81	Zone 13
Native Chicken Rearing	95	74	68	70	75	Zone 13, 18, 2, 21
Native Poultry Rearing	90	72	59	79	73	Zone 13
Pig Rearing	79	83	78	84	77	Zone 13
Saline water fisheries	81	73	73	62	77	Zone 13
Sheep and Duck rearing	79	72	72	60	77	Zone 13, 21
Sheep Rearing	92	82	77	72	81	Zone 13, 2, 21
Stress Tolerant Vegetable (brinjal, rice,red-amaranth, cucumber ..)	77	70	66	65	71	Zone 13, 18, 2
Sunflower cultivation	81	77	64	70	61	Zone 13
Vermicompost	83	77	81	64	67	Zone 13, 2
Watermelon	100	87	76	72	68	Zone 13

3.2.2 Brackishwater Fish Polyculture

The "Brackishwater Fish Polyculture" CALO, situated in the Ganges Tidal Floodplain and Young Meghna Estuarine Floodplain, is evaluated using the Sustainable Livelihoods Framework to assess its viability across physical, social, natural, human, and financial capitals, considering asset coverage and climatic vulnerabilities.

Sustainable Livelihoods Analysis

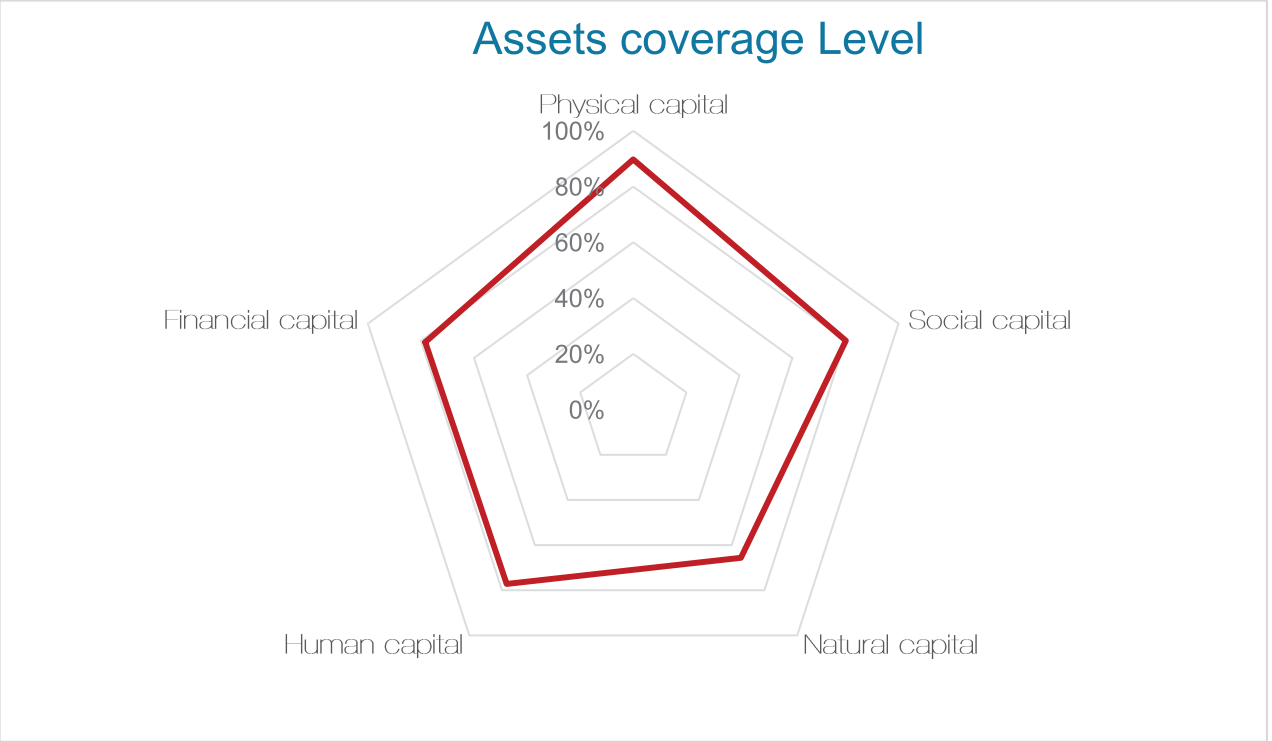


Figure 7: *Livelihood assets coverage for Brackish water Fish Polyculture*

Physical Capital is strong at 90%, supporting aquaculture with essential infrastructure despite environmental stressors. **Social Capital** stands at 80%, enhancing community resilience and resource management. **Natural Capital,** at 66%, faces constraints due to limited land and fluctuating water quality, requiring better management. **Human Capital** is at 77%, with adequate skills but health issues impacting productivity. **Financial Capital,** at 78%, provides good access to financial services but shows economic vulnerabilities during disruptions.

Overall Environmental, social, economic Viability and Strategic Recommendations

The Brackishwater Fish Polyculture has robust physical infrastructure and strong community engagement but struggles with financial stability and environmental impacts. To improve environmental viability, the system should implement efficient water use, restore natural habitats, and regularly monitor water quality and soil salinity while adopting biodiversity-friendly practices. Socially, enhancing community health infrastructure and educational programs can boost human capital and labor productivity. Economically, tailoring financial mechanisms to aquaculture risks and diversifying income through eco-tourism or renewable energy can enhance resilience. Overall, while the system is well-supported physically and socially, strengthening its environmental and economic aspects is essential for long-term sustainability and resilience in floodplain conditions.

3.2.3 Carp Polyculture

The "Carp Polyculture" Climate Adaptive Livelihood Option (CALO) is implemented within the Ganges Tidal Floodplain (Zone 13) and Young Meghna Estuarine Floodplain (Zone 18). This analysis uses the Sustainable Livelihoods Framework to assess the viability across various capitals: physical, social, natural, human, and financial, integrating specific asset coverage levels and climatic vulnerabilities pertinent to these floodplain areas.

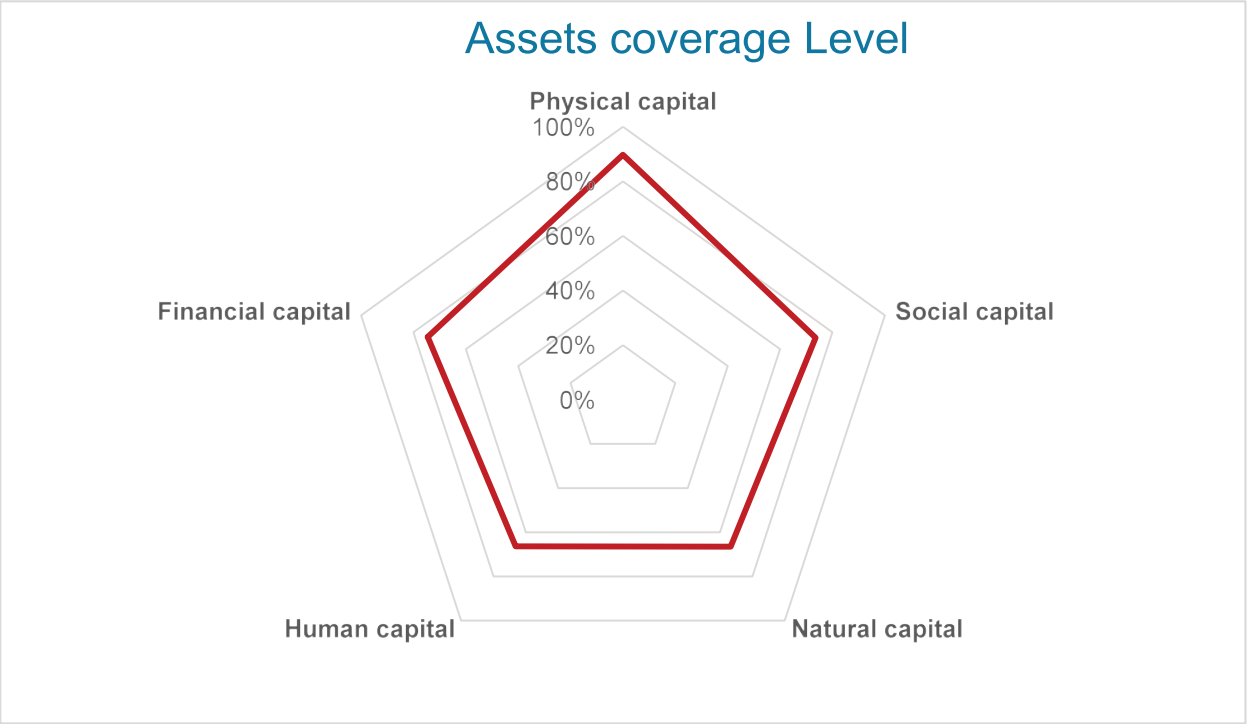


Figure 8: *Livelihood assets coverage for Carp Polyculture*

Sustainable Livelihoods Analysis

Carp Polyculture benefits from strong physical capital with a 90% coverage, ensuring effective aquaculture practices despite environmental stressors. Social capital stands at 74%, reflecting robust community engagement in resource management and resilience to climatic disruptions. However, natural capital is at 67%, revealing challenges in accessing and sustaining essential resources due to environmental impacts. Human capital is at 66%, indicating sufficient education but notable health issues affecting productivity. Financial capital, at 75%, shows good access to services but highlights vulnerabilities in economic stability during disruptions. Overall, while infrastructure and community support are strong, improving natural resource management, health services, and financial stability is crucial for sustained resilience.

Overall Environmental, social, economic Viability and Strategic Recommendations

Carp Polyculture benefits from solid infrastructure and community engagement, with 90% physical capital coverage supporting operations against environmental stressors. However, challenges in natural capital (67%) and human capital (66%) due to resource access, biodiversity impacts, and health issues need addressing. Enhancing water practices, restoring habitats, and improving health services are essential. Financial capital at 75% shows good access to loans but highlights economic vulnerabilities. Strengthening financial mechanisms and diversifying income sources are needed for long-term viability in floodplain conditions.

3.2.4 Crab Fattening

Crab Fattening is another Climate Adaptive Livelihood Option (CALO) specifically tailored to thrive in the unique conditions of the Ganges Tidal Floodplain (Zone 13). This region presents a landscape heavily influenced by monsoonal tidal activities, which shape both the environment and the agricultural practices of the area.

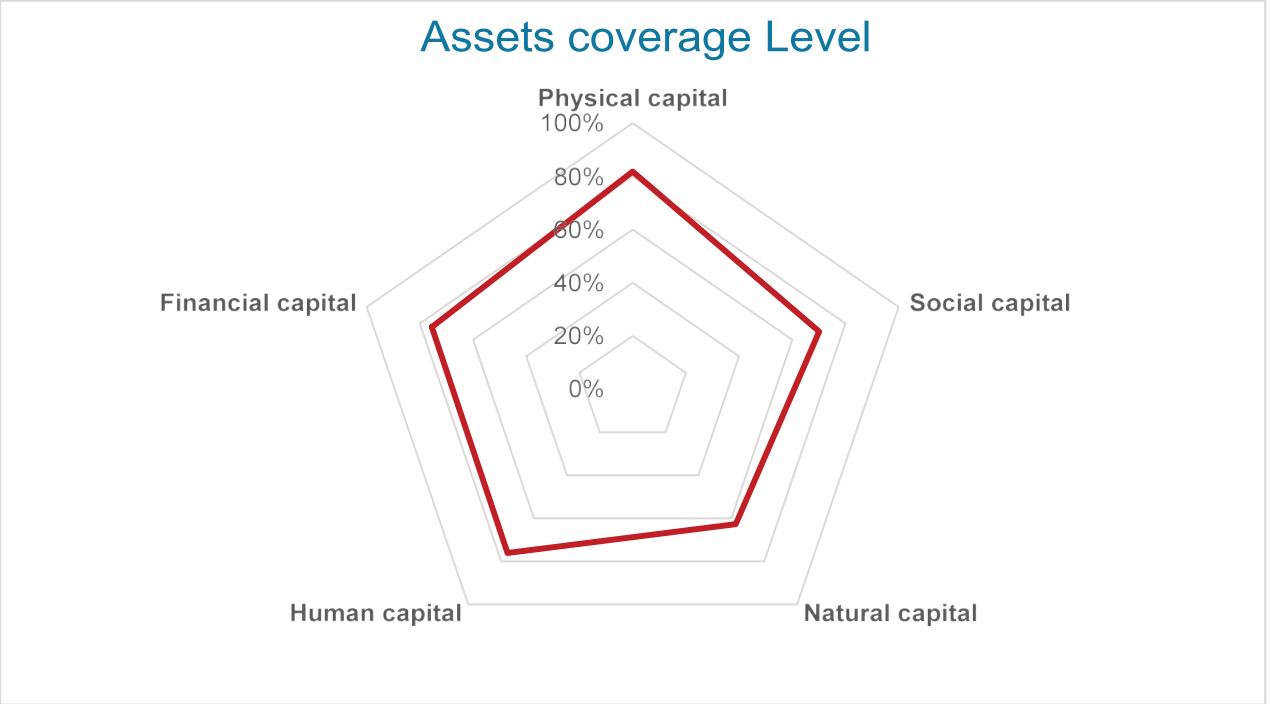


Figure 9: *Livelihood assets coverage for Crab Fattening*

Sustainable Livelihoods Analysis

Crab Fattening benefits from strong **physical capital** (82%) supporting effective aquaculture management in challenging conditions like variable salinity and flooding. **Social capital** at 70% reflects robust community engagement and resource management, vital for handling environmental disruptions. However, **natural capital** is at 63%, indicating challenges with resource access and ecosystem impacts, necessitating improved sustainable management. **Human** and **financial capital** both score 76%, showing adequate education and financial access but highlighting risks from health issues and income instability. Addressing these challenges through improved health services, resource management, and financial strategies is crucial for long-term viability.

Overall Viability and Strategic Recommendations

Crab Fattening in the Ganges Tidal Floodplain benefits from strong physical and financial foundations but faces challenges in natural capital (63%) and needs better environmental management. Implementing sustainable aquaculture practices, restoring natural habitats, and regular monitoring are essential for improving environmental viability. Social capital at 70% shows solid community cooperation but requires enhanced health and safety programs and greater engagement in sustainability. Economic viability can be improved by diversifying income sources and introducing risk management strategies. Overall, addressing these areas through targeted strategies will enhance the long-term sustainability and resilience of crab fattening operations.

3.2.5 Duck & Fish Farming

The Duck & Fish Farming operates within the Ganges Tidal Floodplain (Zone 13) and Young Meghna Estuarine Floodplain (Zone 18).

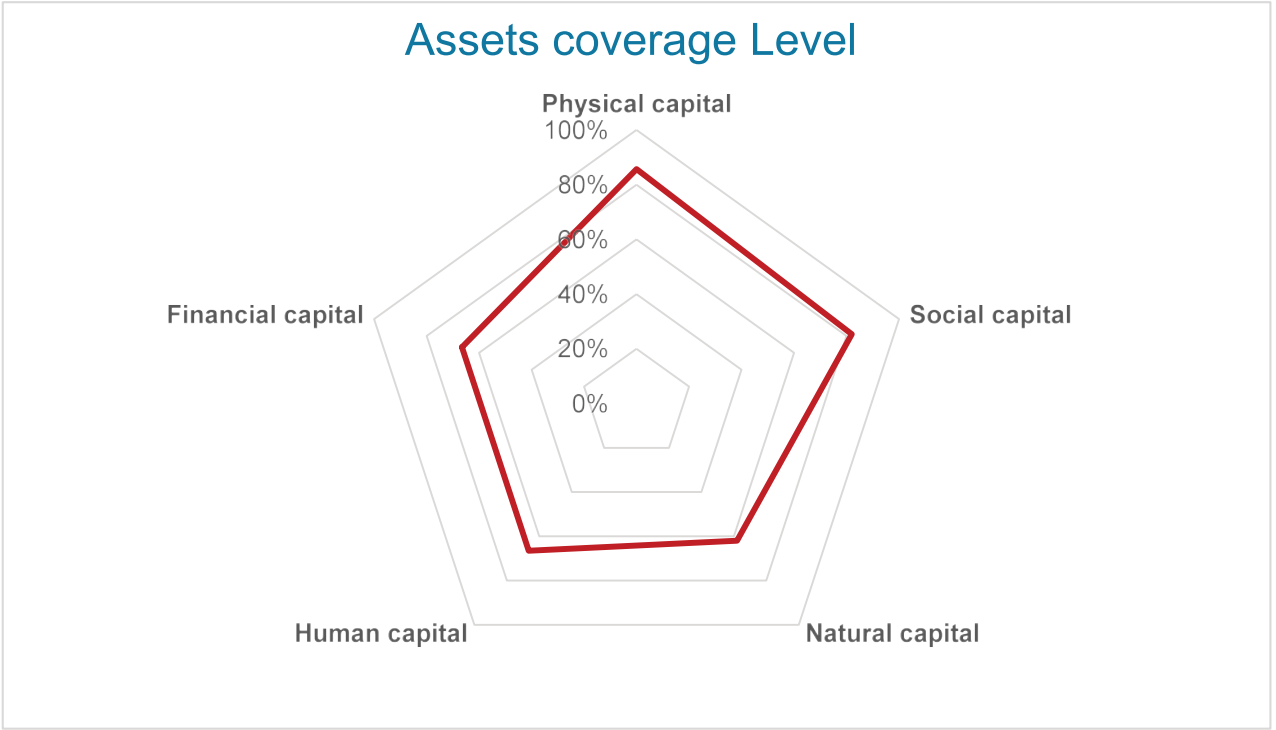


Figure 10: *Livelihood assets coverage for Duck & Fish Farming*

Sustainable Livelihoods Analysis

Duck & Fish Farming shows strong physical capital with 86% coverage, supporting effective farming despite environmental stressors. Social capital is also high at 82%, indicating strong community cohesion and resource management. However, natural capital at 62% reveals challenges with resource access and conservation, and human capital at 66% highlights the need for better healthcare and education. Financial capital at 67% shows decent access to loans but points to vulnerabilities in income stability. Addressing these issues through improved resource management, healthcare, and financial strategies is crucial for enhancing sustainability and resilience.

Overall Viability and Strategic Recommendations

Duck & Fish Farming benefits from strong infrastructure (86%) and community engagement (82%), essential for managing environmental stressors. However, natural capital at 62% requires improved resource management and ecological practices. Financial capital at 67% needs enhancement through diversified income strategies and tailored financial products to mitigate economic risks. To ensure long-term viability, focusing on environmental management, boosting social and economic resilience, and implementing targeted health and education programs are crucial for sustainability in the Ganges Tidal and Young Meghna Estuarine Floodplains.

3.2.6 Duck Rearing

The Duck Rearing CALO is strategically implemented in the Ganges Tidal Floodplain and Sylhet Basin, where unique climatic and environmental conditions, including monsoon flooding and variable salinity, shape its feasibility and sustainability.

Sustainable Livelihoods Analysis

Duck Rearing in the Ganges Tidal Floodplain and Sylhet Basin shows **strong physical** (89%) and **social (80%) capital,** with robust infrastructure and active community participation. However, **natural capital (73%)** faces challenges from resource scarcity and biodiversity impacts, while **human capital (71%)** is limited by gaps in education and health, and **financial capital** (69%) struggles with access to services and income stability. Addressing these issues is crucial for sustaining duck rearing operations amidst fluctuating environmental conditions.

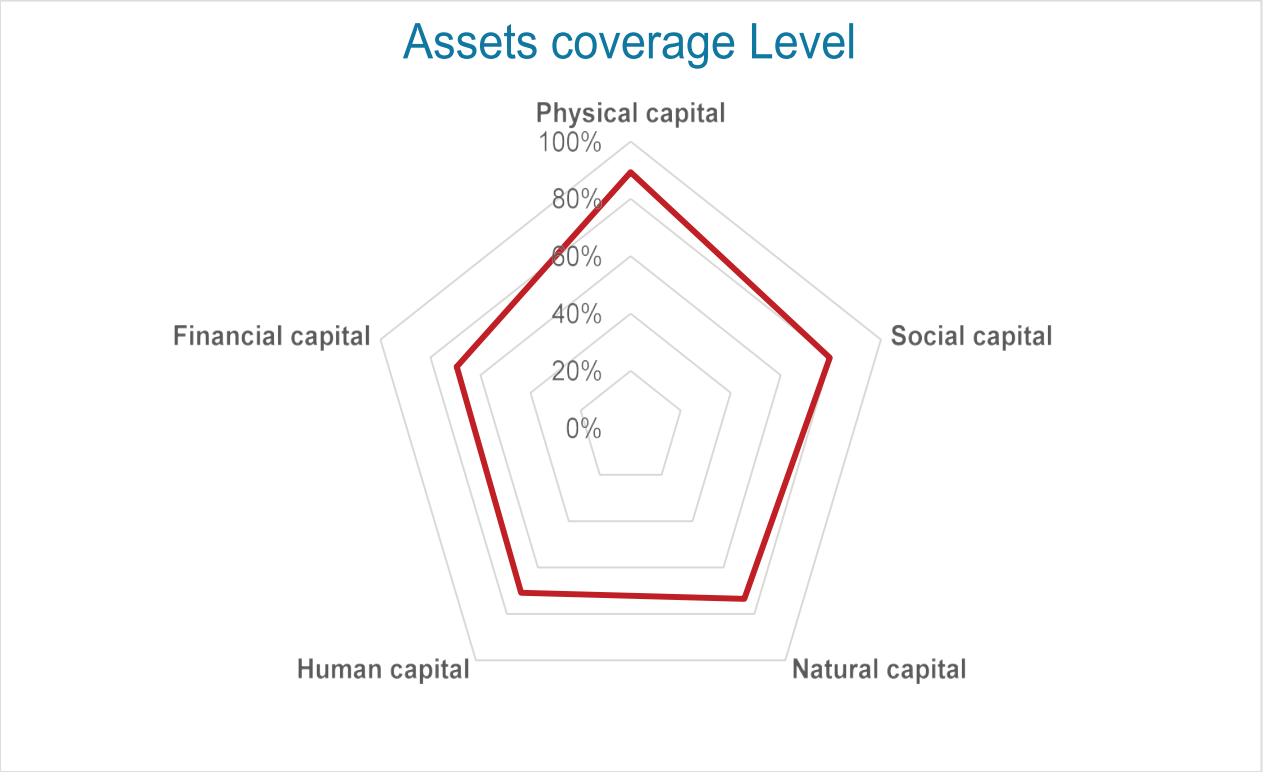


Figure 11: *Livelihood assets coverage for Duck Rearing*

Overall Viability and Strategic Recommendations

Duck Rearing in the Ganges Tidal Floodplain and Sylhet Basin benefits from strong physical and social foundations, but faces challenges in natural and financial capitals. To enhance environmental sustainability, improved water management and biodiversity conservation are needed. Strengthening social resilience through better healthcare and education can address human capital issues, while bolstering economic stability through financial support systems and income diversification is crucial. Targeted interventions in these areas will be key to sustaining and expanding this CALO amid evolving climatic conditions.

3.2.7 F1 Calf Rearing

The "F-1 Calf Rearing" Climate Adaptive Livelihood Option (CALO) is strategically implemented in the Active Tista Floodplain, leveraging the unique environmental and climatic conditions of the area to foster sustainable livestock practices.

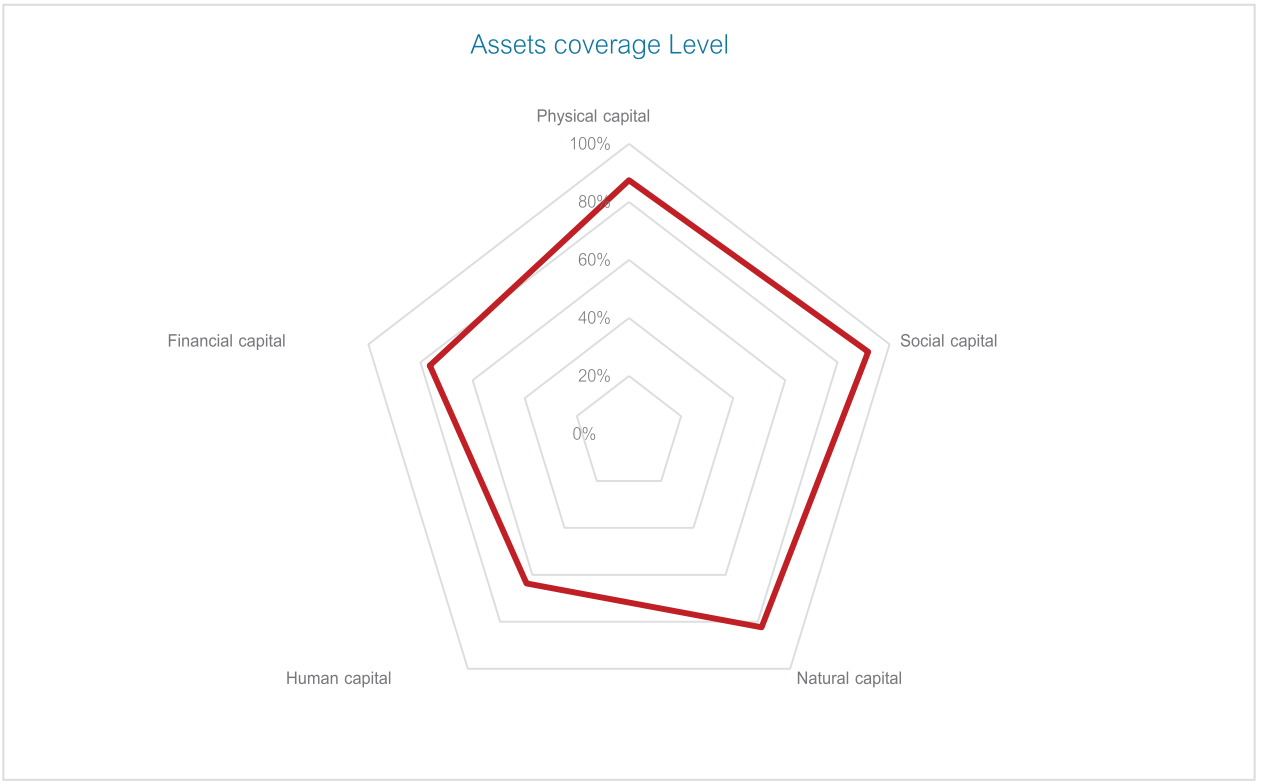


Figure 12: *Livelihood assets coverage for F1 Calf Rearing*

Sustainable Livelihoods Analysis

Calf rearing in the region benefits from strong **physical** (88%) and **social** (92%) capital, with well-maintained infrastructure and excellent community cohesion aiding livestock management amidst challenging conditions. **Natural capital** is also relatively good at 82%, though there are concerns about biodiversity and climate impacts. **Human capital** is lower at 64%, indicating a need for better education and healthcare. **Financial capital** at 76% shows decent access to loans but highlights concerns about income stability. Addressing these areas will be crucial for the sustainable development and resilience of calf rearing activity.

Overall Viability and Strategic Recommendations

F-1 Calf Rearing in the Tista Floodplain benefits from strong physical infrastructure but requires improved natural resource management and sustainable practices to mitigate environmental impacts. High social capital supports collective action, and enhancing education and training can further bolster resilience. Economic stability can be improved by diversifying income sources and adopting risk management strategies. Strategic investments in these areas are essential for the long-term viability and resilience of calf rearing in this flood-prone region.

3.2.8 Green Job (Bamboo-based Handicraft)

Frequent monsoon-induced flooding in The Ganges Tidal Floodplain presents unique challenges, including soil salinity alterations and land usability disruptions, impacting bamboo cultivation and handicraft production logistics.

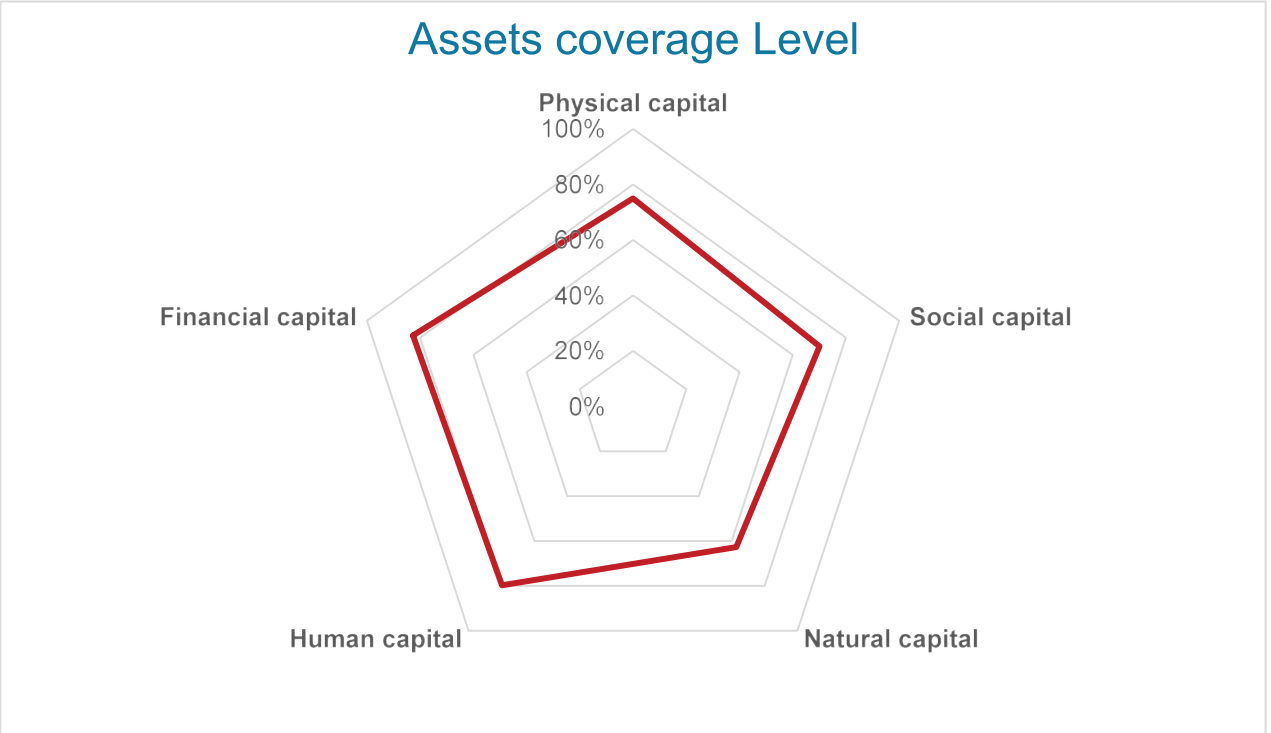


Figure 13: *Livelihood assets coverage for Green Job*

Sustainable Livelihoods Analysis

Handicraft production benefits from robust physical (75%) and financial (83%) capital, with good access to materials and services, though frequent flooding challenges supply stability. Social capital at 71% indicates strong community networks but needs improved decision-making participation. Natural capital is lower at 63%, with ongoing issues from flooding affecting bamboo cultivation and ecological balance, requiring better resource management. Human capital is strong at 80%, but health and sanitation issues impact productivity. Addressing these challenges through enhanced management practices, community engagement, and economic resilience will be key for sustaining handicraft activities in the flood-prone region.

Overall Viability and Strategic Recommendations

To enhance the Green Job initiative's sustainability in the Ganges Tidal Floodplain, it's crucial to implement flood-resistant bamboo cultivation, reduce environmental impact, and monitor soil and water quality. Strengthening social resilience through improved decision-making participation and community engagement, and establishing cooperative groups can bolster collective power and market presence. Economic stability can be supported by tailored financial products, microloans, insurance, and diversification of handicraft products. Addressing these environmental, social, and economic challenges will ensure the long-term viability and growth of the bamboo-based handicraft sector despite regional climatic challenges.

3.2.9 Integrated Agriculture and poultry

Integrated Agriculture and Poultry operates within the diverse ecological zones of Ganges Tidal Floodplain (Zone 13), Young Meghna Estuarine Floodplain (Zone 18), and Sylhet Basin (Zone 21), each presenting unique environmental challenges and opportunities. This ClimateAdaptive Livelihood Option (CALO) strategically combines crop cultivation with poultry farming to maximize land use and resource efficiency, catering to the specific climatic and soil conditions of these zones.

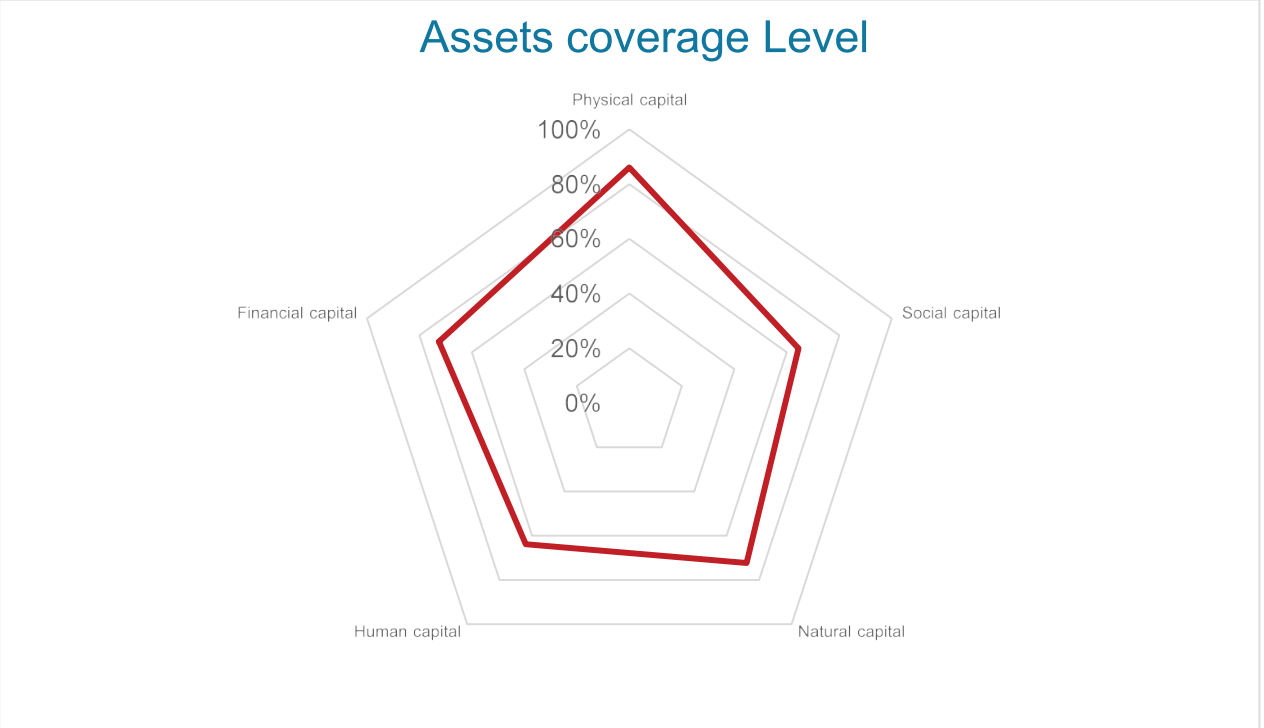


Figure 14: *Livelihood assets coverage for Integrated Agriculture and poultry*

Sustainable Livelihoods Analysis

The CALO benefits from strong physical capital (86%) with robust infrastructure and resources for farming and poultry, essential for coping with environmental pressures. Social capital is moderately strong at 64%, reflecting good community cooperation but needing enhanced engagement. Natural capital at 72% indicates adequate resource access but concerns over variability and biodiversity impacts. Human capital at 64% shows reasonable education and skills but requires better health and technology adaptation. Financial capital is relatively strong at 73%, yet income stability and investment returns need improvement through diversification and better financial planning.

Overall Viability and Strategic Recommendations

The Integrated Agriculture and Poultry CALO in Zones 13, 18, and 21 shows strong physical and financial capital but faces environmental, social, and economic challenges. To enhance environmental viability, adopting sustainable farming practices and regular assessments are crucial. Strengthening social capital through community training and initiatives can improve resilience. Economic stability can be improved by diversifying income sources, developing value-added products, and enhancing financial literacy. Addressing these areas will ensure long-term sustainability and success despite climatic and economic challenges.

3.2.10 Integrated Agriculture Farming

Integrated Agriculture Farming is a Climate Adaptive Livelihood Option (CALO) operational within multiple geographically diverse regions: Zone 13 (Ganges Tidal Floodplain), Zone 18 (Young Meghna Estuarine Floodplain), Zone 2 (Active Tista Floodplain), and Zone 21 (Sylhet Basin).

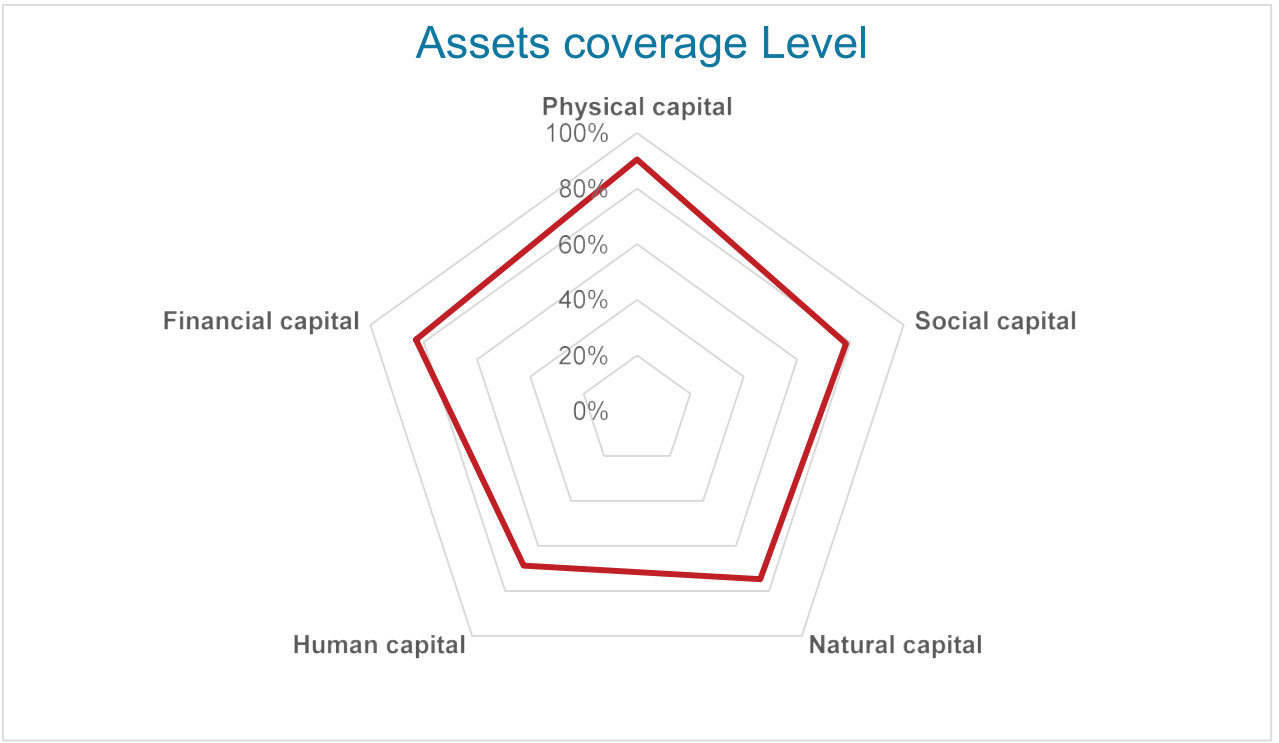


Figure 15: *Livelihood assets coverage for Integrated Agriculture Farming*

Sustainable Livelihoods Analysis

The CALO in the Tista Floodplain and Ganges Tidal areas benefits from high **physical** (90%) and **financial** (83%) capital, providing robust infrastructure and financial support for agriculture and poultry. **Social capital** is **strong** at 78%, with effective community engagement enhancing resilience. However, **natural capital** is lower at 75%, indicating challenges in sustainable resource management due to environmental variability. **Human capital** is the weakest at 69%, with issues in education, health, and skills impacting productivity. Addressing these gaps through targeted environmental management, health interventions, and financial risk strategies is crucial for sustaining and improving the CALO's effectiveness.

Overall Viability and Strategic Recommendations

Integrated Agriculture Farming shows strong physical and financial capital but faces challenges in environmental and social viability. To improve environmental sustainability, better natural resource management and sustainable farming practices are needed. Strengthening social capital through enhanced health programs and education can increase resilience. Economic stability can be bolstered by diversifying income sources and introducing insurance schemes. Addressing these gaps will enhance the CALO's sustainability and resilience, making it a robust model for integrated rural development.

3.2.11 Integrated vegetable cultivation

Integrated vegetable cultivation a Climate Adaptive Livelihood Option (CALO) operational within multiple geographically diverse regions: Zone 13 (Ganges Tidal Floodplain), Zone 18 (Young Meghna Estuarine Floodplain) , and Zone 2 (Active Tista Floodplain).

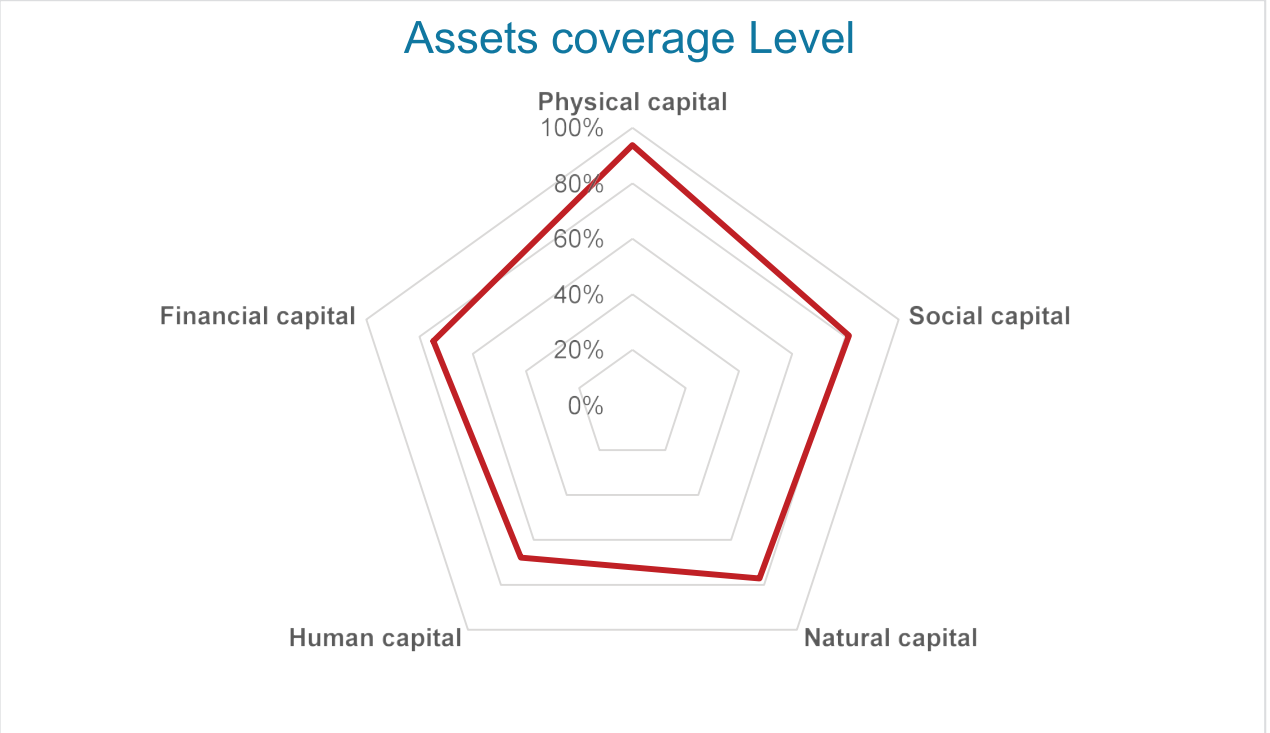


Figure 16: *Livelihood assets coverage for Integrated Vegetable Cultivation*

Sustainable Livelihoods Analysis

Integrated vegetable cultivation benefits from a strong **physical capital** coverage of 94%, supporting effective management of plots despite varying climates and flood risks. **Social capital** at 81% highlights robust community cooperation and decision-making, crucial for adapting to environmental and market changes. However, **natural capital** at 77% shows vulnerabilities due to limited land access and fluctuating resource quality, requiring better land management and sustainable practices. **Human capital** is lower at 68%, indicating gaps in education and health, which affect farming efficiency. **Financial capital** at 75% shows good access to services but highlights concerns about income stability and investment viability.

Overall Viability and Strategic Recommendations

To enhance environmental sustainability in integrated vegetable cultivation, it's crucial to adopt advanced soil and water conservation methods, use climate-resilient crops, and implement sustainable pest management to address soil salinity and support biodiversity. Socially, strengthening community training and support networks can improve resilience and adaptation. Economically, diversifying income sources and improving financial literacy and insurance access can buffer against climate and market fluctuations. While the initiative shows strong physical and social foundations, addressing gaps in natural and human capitals through targeted interventions is essential for long-term viability and sustainability.

3.2.12 Maize Cultivation

Maize Cultivation in Zones 13 and 2 utilizes specific geographic and environmental contexts to enhance agricultural outputs, with its effectiveness and sustainability evaluated through various capital assessments and climatic influences.

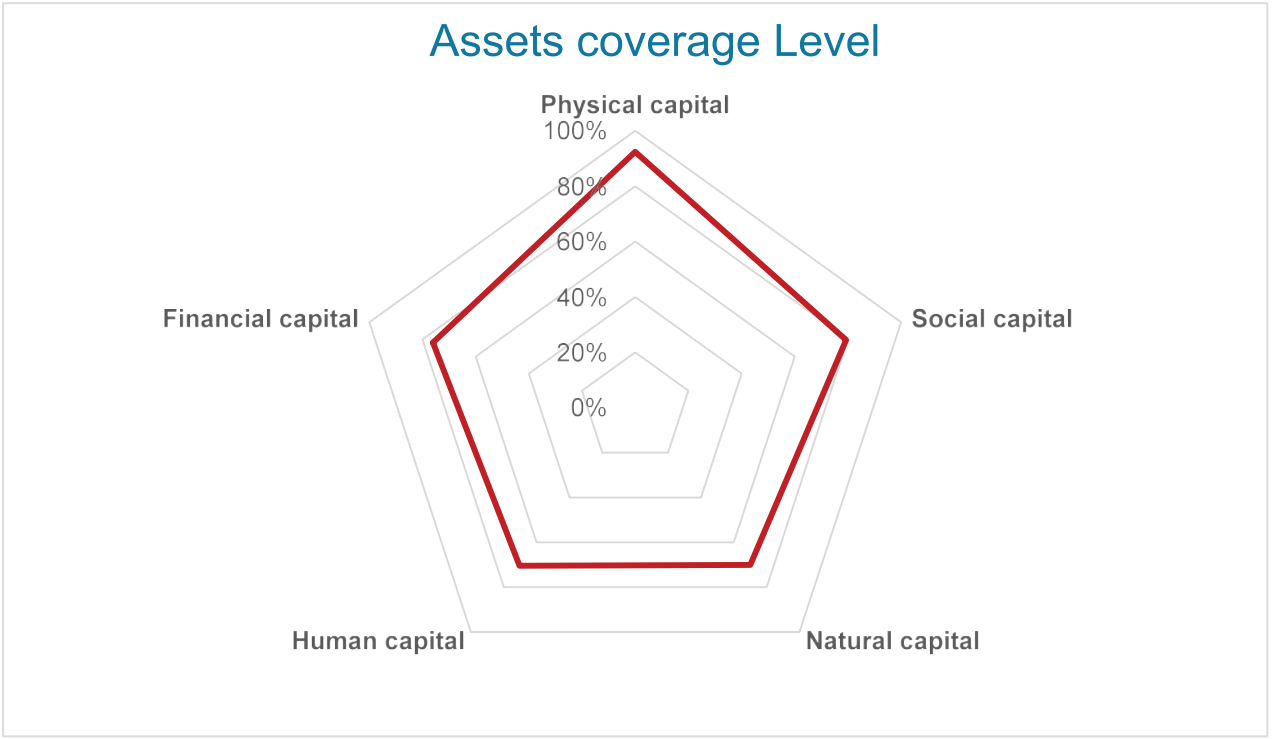


Figure 17: *Livelihood assets coverage for Maize Cultivation*

Sustainable Livelihoods Analysis

Maize Cultivation in Zones 13 and 2 benefits from high **physical capital** (94%) with robust infrastructure, strong **social capital** (79%) enabling effective community cooperation, and moderate **natural capital** (77%) facing challenges like soil salinity and erosion. **Human capital** is lower at 68%, indicating a need for improved education and health, while **financial capital** at 75% provides reasonable access to credit but needs better income stability.

Overall Viability and Strategic Recommendations

Maize Cultivation in Zones 13 and 2 benefits from strong physical and social capitals but needs improvements in environmental and human capitals. To enhance sustainability, adopting soil health practices, strengthening disaster preparedness, and diversifying income through value-added products and improved infrastructure are crucial. These targeted interventions will improve environmental sustainability, social resilience, and economic stability, ensuring the long-term viability of maize cultivation in these flood-prone regions.

3.2.13 Mung bean cultivation

Mung bean cultivation operates within Zone 13 (Ganges Tidal Floodplain), leveraging specific geographic and environmental contexts to optimize its agricultural outputs. Below, we analyze the effectiveness of this Climate Adaptive Livelihood Option (CALO) based on various capital assessments and climatic influences that impact the viability and sustainability of maize cultivation in these regions.

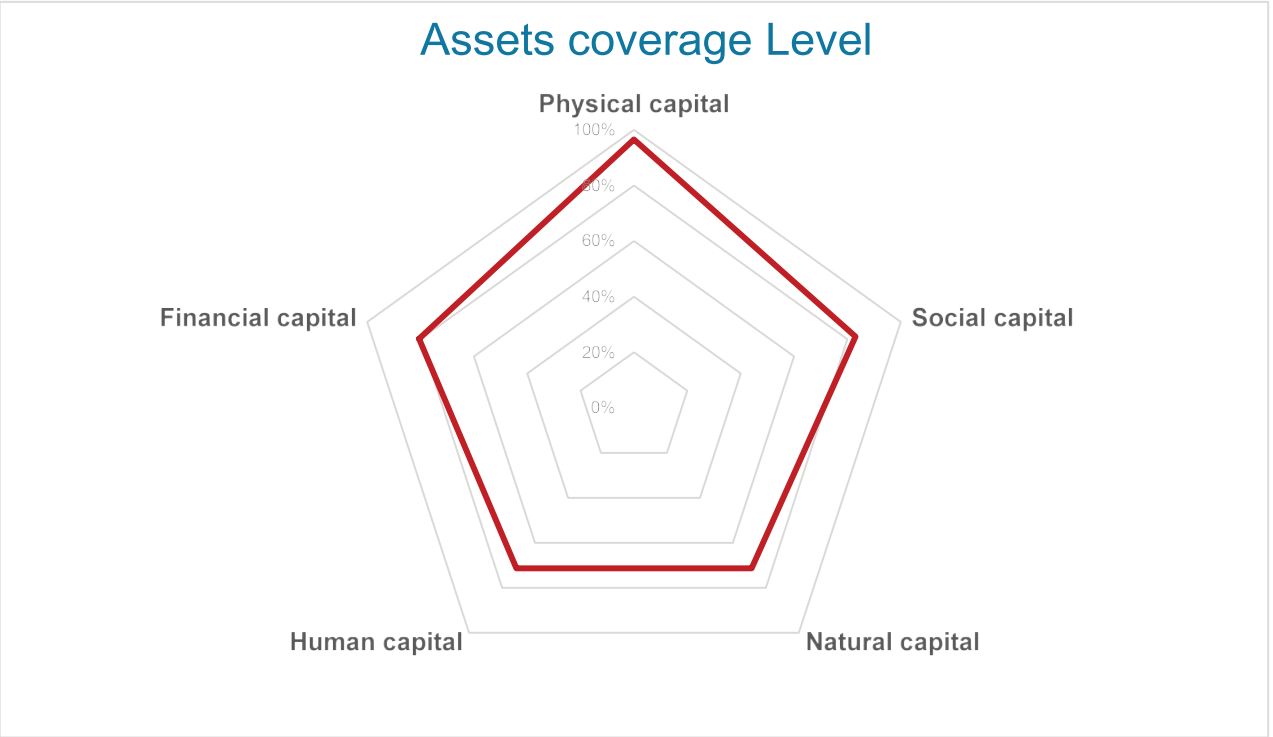


Figure 18: *Livelihood assets coverage for Mung Bean Cultivation*

Sustainable Livelihoods Analysis

Mung bean cultivation in the Ganges Tidal Floodplain benefits from excellent **physical capital** (97%) and strong **social capital** (83%), with robust infrastructure and effective community engagement supporting high productivity. However, challenges exist with **natural capital** (71%) due to salinity and flooding, and **human capital** (70%) requires improvements in health and training. **Financial capital** is relatively strong at 76%, but better financial planning and risk management are needed to address income variability and environmental impacts. Enhancing these areas will ensure the sustainability and resilience of mung bean cultivation in the region.

Overall Viability and Strategic Recommendations

Mung bean cultivation in Zone 13 faces challenges from soil salinity and waterlogging, which can be mitigated by implementing soil health monitoring, salinity management, and using salt-tolerant varieties. Strengthening local institutions and enhancing cooperative practices can improve social resilience, while introducing value-added processing and better market linkages will support economic stability. Despite strong physical and financial capitals, targeted interventions are needed to address natural and human capital gaps to enhance the sustainability and resilience of mung bean farming in the Ganges Tidal Floodplain.

3.2.14 Native Chicken Rearing

Native Chicken Rearing is implemented in Zone 13 (Ganges Tidal Floodplain), Zone 18 (Young Meghna Estuarine Floodplain), Zone 2 (Active Tista Floodplain), and Zone 21 (Sylhet Basin). These regions pose unique environmental and socio-economic challenges, which influence the viability of chicken rearing.

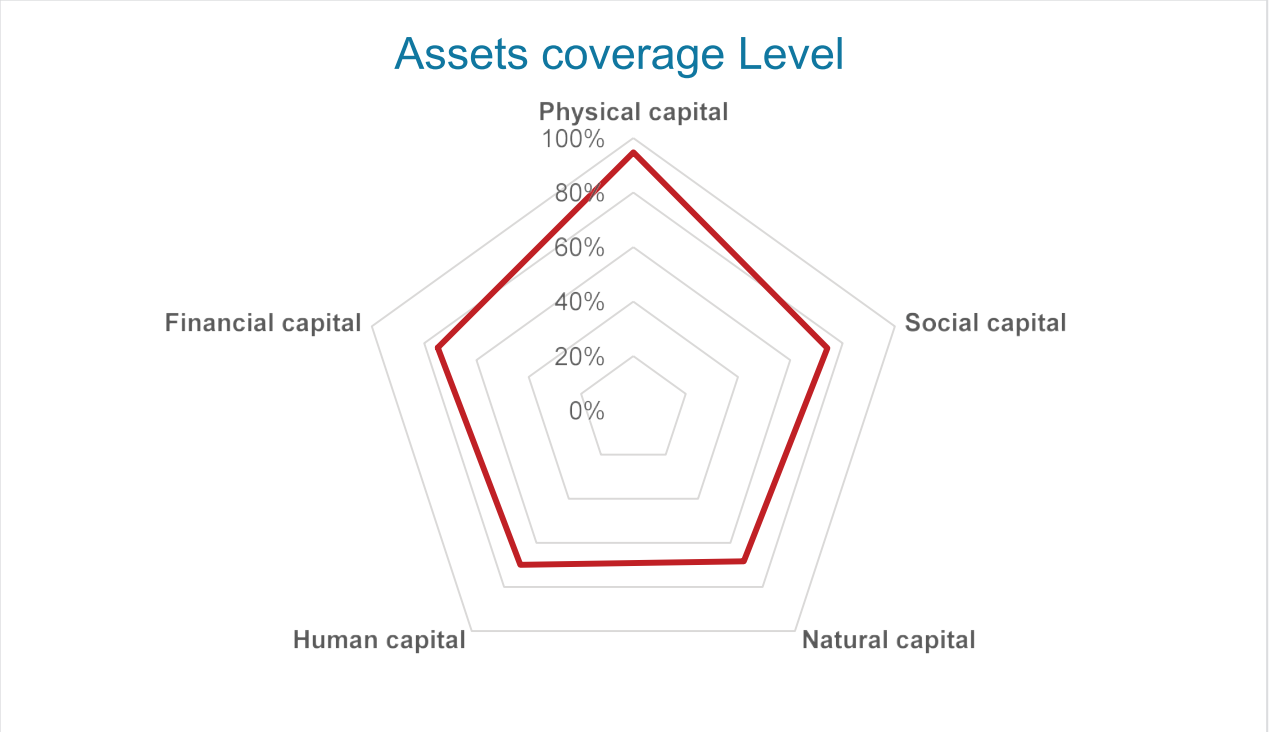


Figure 19: *Livelihood assets coverage for Native Chicken Rearing*

Sustainable Livelihoods Analysis

Native Chicken Rearing benefits from strong **physical capital** with 95% coverage, supported by excellent infrastructure and resources. **Social capital** is moderately strong at 74%, reflecting good community trust and decision-making. However, **natural capital** is lower at 68% due to variable land access and resource availability, while **human capital** at 70% faces challenges from health issues affecting productivity. **Financial capital**, with 75% coverage, shows reasonable access to loans but highlights income variability that impacts economic stability. Addressing these gaps with targeted strategies will enhance the sustainability and resilience of native chicken rearing.

Overall Viability and Strategic Recommendations

Native Chicken Rearing shows strong potential with excellent infrastructure and community support. To enhance environmental viability, it's crucial to address natural capital challenges through improved water management and climate adaptation. Social viability can be boosted by strengthening community initiatives and education on sustainable practices. Economic stability can be improved by diversifying income sources and developing value-added products. Overall, focusing on natural resource management, health services, and economic diversification will ensure the long-term sustainability and resilience of chicken rearing in these zones.

3.2.15 Native Poultry Rearing

Native Chicken Rearing is practiced across diverse zones like the Ganges Tidal Floodplain, Young Meghna Estuarine Floodplain, Active Tista Floodplain, and Sylhet Basin, each presenting distinct environmental and socio-economic challenges.

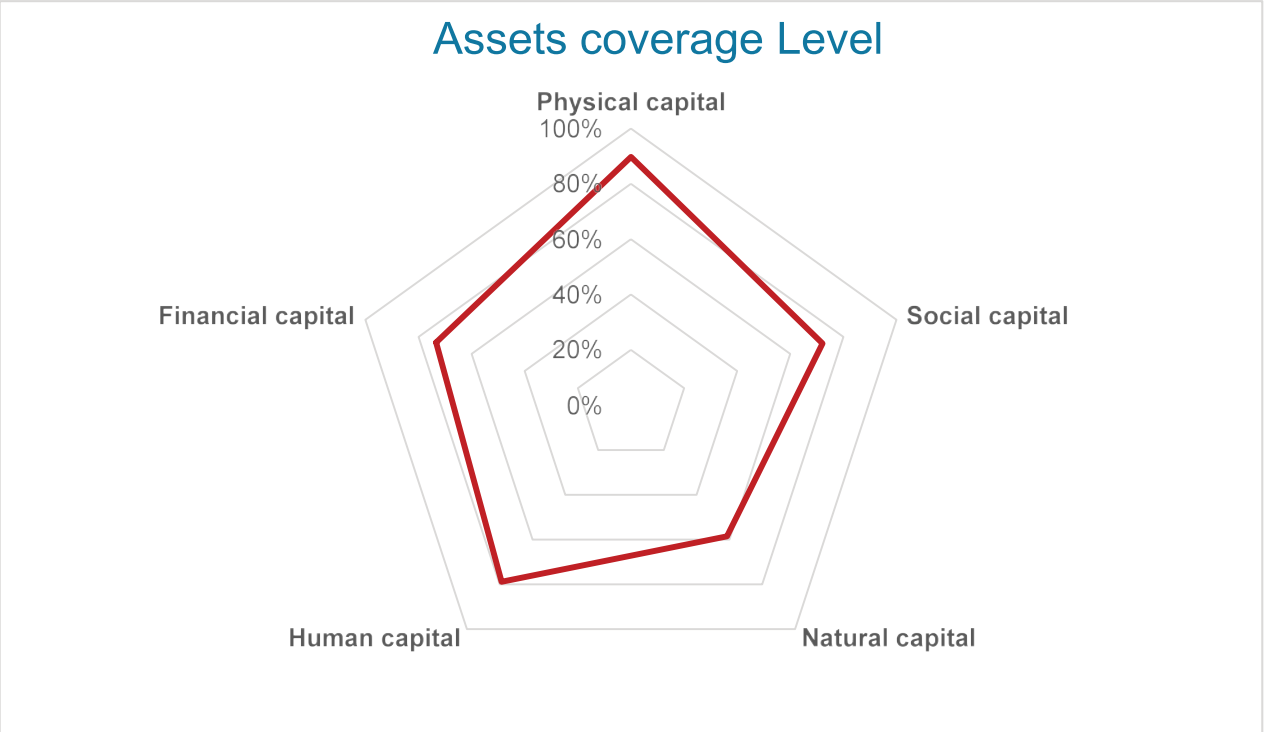


Figure 20: Livelihood assets coverage for Native Poultry Rearing

Sustainable Livelihoods Analysis

Native Poultry Rearing shows excellent physical capital at 95% coverage with robust infrastructure, while social capital at 72% reflects good community collaboration in zone 13. However, natural capital is lower at 59%, highlighting challenges related to land and water access in the floodplain. Human capital, at 70%, shows adequate education and skills but requires further development, and financial capital is reasonably strong at 75%, though income stability needs improvement. Addressing these gaps will be crucial for enhancing the sustainability and resilience of poultry rearing in the region.

Overall Viability and Strategic Recommendations

In Zone 13, Native Poultry Rearing is supported by strong infrastructure but faces environmental challenges from flooding and salinity. To enhance sustainability, strategies should include building flood-resistant structures and adopting ecological farming practices. Strengthening community bonds and leadership skills will improve social resilience, while diversifying income sources and local market connections can stabilize the economy. Addressing these areas will improve the overall viability and sustainability of poultry rearing in the floodplain region.

3.2.16 Pig Rearing

Set within the Ganges Tidal Floodplain, this region's fertile lands are enriched by nutrient-rich silt from tidal activities, offering a promising yet challenging environment for agriculture due to issues like flooding and soil salinity. These conditions pose unique challenges and opportunities for pig rearing.

Sustainable Livelihoods Analysis:

Pig Rearing showcases excellent physical capital with a 95% coverage, supported by well-constructed pig sheds (2.79), ample feeding resources (2.87), and comprehensive veterinary services (2.95). Social capital is also strong at 83%, with high trust (2.45) and active participation (2.41). Natural capital is moderately adequate at 71%, with scores indicating room for improvement in ecological integration (land access 2.12, biodiversity impact 2.33). Human capital stands at 72%, with robust education (2.34) and skill sufficiency (2.70), though health needs enhancement (2.83). Financial capital is reasonably secure at 75%, with decent access to loans (2.16) and financial services (2.54), but requires improved investment strategies (2.12).

Overall Viability and Strategic Recommendations:

Pig rearing in the Ganges Tidal Floodplain shows strong foundations but requires improvements in environmental management, community training, and economic strategies. Implementing waste management and low-impact feeding techniques can reduce ecological impacts, while enhanced community training and emergency networks will bolster resilience. Diversifying income sources and improving market access are vital for economic stability. Addressing these areas will ensure the long-term success and expansion of pig rearing in the region.

3.2.17 Saline water Fisheries

Saline water Fisheries is another Climate Adaptive Livelihood Option (CALO) specifically tailored to thrive in the unique conditions of the Ganges Tidal Floodplain (Zone 13). This region presents a landscape heavily influenced by saline water, which shapes both the environment and the agricultural practices of the area.

Sustainable Livelihoods Analysis

Saline water fisheries in the Ganges Tidal Floodplain demonstrate strong physical and **financial capital,** with 81% coverage for **physical** resources and 77% for financial services. However, social capital and **natural capital** are moderately covered at 73%, reflecting adequate community engagement and access to resources but indicating room for improvement. **Human capital** is the weakest area with 62% coverage, highlighting significant gaps in education, skills, and health among workers. Enhancing specialized training, health support, and biodiversity conservation practices will be crucial for improving overall sustainability and productivity in this sector.

Overall Viability and Strategic Recommendations

Saline water fisheries in the Ganges Tidal Floodplain are well-supported by physical and financial resources but need improvement in biodiversity impact and human capital. Enhancing sustainable practices, community involvement, and workforce skills, along with investing in technology for better resource management, are crucial for boosting environmental sustainability and economic stability. Targeted interventions in these areas can significantly improve the overall viability and long-term success of the fisheries.

3.2.18 Sheep and Duck Rearing

"Sheep and Duck Rearing" Climate Adaptive Livelihood Option (CALO) operates in the Ganges Tidal Floodplain (Zone 13) and the Sylhet Basin (Zone 21). We analyzed the CALO's viability focusing on various aspects of sustainable livelihoods and strategic recommendations for environmental, social, and economic viability.

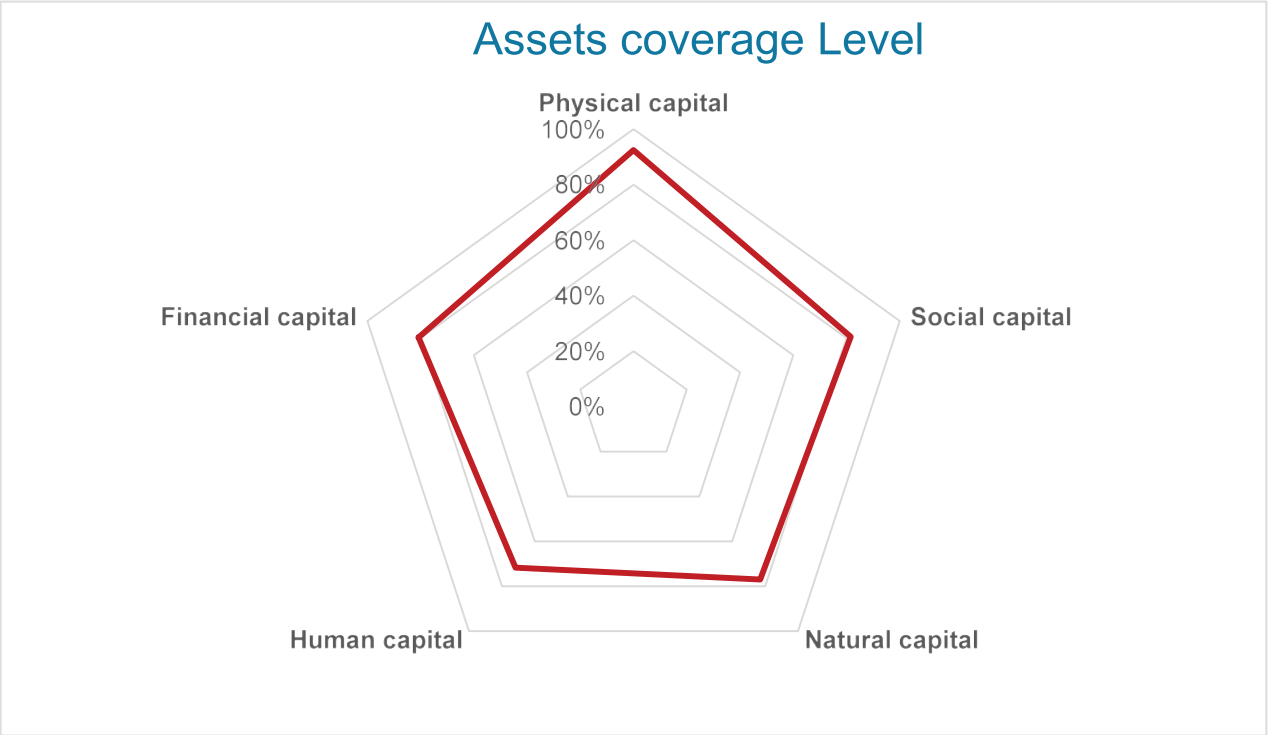


Figure 23: *Livelihood assets coverage for Sheep and Duck Rearing*

Sustainable Livelihoods Analysis

The Sheep and Duck Rearing initiative in Zones 13 and 21 is well-supported with strong physical and financial capital, achieving 79% and 77% coverage respectively. Social capital is satisfactory at 72%, fostering collaboration and resilience. However, natural capital (72%) and human capital (60%) require improvements, particularly in minimizing ecological impact and enhancing education and health. Addressing these gaps with sustainable practices, capacity-building, and better financial management will improve the overall effectiveness and sustainability of the rearing activities.

Overall Viability and Strategic Recommendations

To enhance the Sheep and Duck Rearing initiative in Zones 13 and 21, implementing sustainable grazing and waste management practices is crucial for environmental sustainability. Strengthening community engagement and decision-making will boost social resilience. Economic stability can be improved by diversifying income sources, expanding market access, and enhancing financial education. While the initiative has solid physical and financial foundations, addressing gaps in human and social capital through targeted interventions will be key to achieving long-term sustainability and resilience.

3.2.19 Sheep Rearing

Sheep Rearing operates within Zone 13 (Ganges Tidal Floodplain), Zone 2 (Active Tista Floodplain), and Zone 21 (Sylhet Basin). This CALO has been assessed across multiple dimensions to determine its sustainability and overall viability.

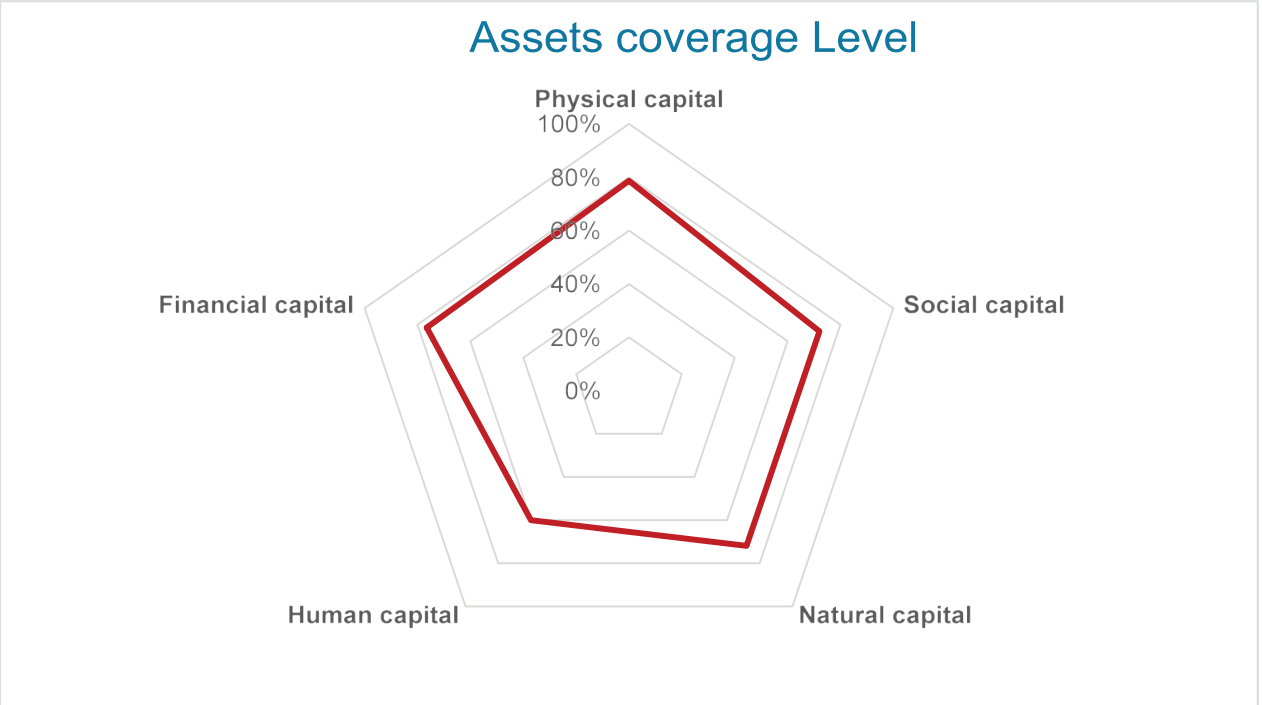


Figure 24: *Livelihood assets coverage for Sheep Rearing*

Sustainable Livelihoods Analysis

The Sheep Rearing initiative shows strong physical capital with 92% coverage, including excellent access to grazing land, sheds, and veterinary services, crucial for effective livestock management. Social capital is also robust at 82%, with high levels of trust and participation in decision-making, enhancing community support. Natural capital is solid at 77%, though some vulnerability to local climate conditions exists. Human capital, at 72%, indicates moderate investment in education, health, and skills, with room for improvement. Financial capital is strong at 81%, ensuring stability through good access to loans and financial services. Overall, while the initiative is well-supported in several areas, further improvements in human capital and adaptation to climatic challenges are needed for long-term sustainability.

Overall Viability and Strategic Recommendations

Sheep Rearing in Zones 13, 2, and 21 showcases high environmental sustainability with effective management of grazing land and minimal biodiversity impact, though climate resilience could be improved. Social resilience is strong, supported by high community trust and cooperation, but further engagement and educational programs could enhance it. Economic stability is robust, underpinned by solid financial resources, yet improving human capital in education and health is crucial for long-term stability and adaptability. Overall, the initiative is highly viable, benefiting from strong physical and financial support, with key improvements needed in climate resilience and human capital.

3.2.20 Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber)

Stress Tolerant Vegetable cultivation operates within Zone 13 (Ganges Tidal Floodplain), Zone 18 (Young Meghna Estuarine Floodplain), and Zone 2 (Active Tista Floodplain).

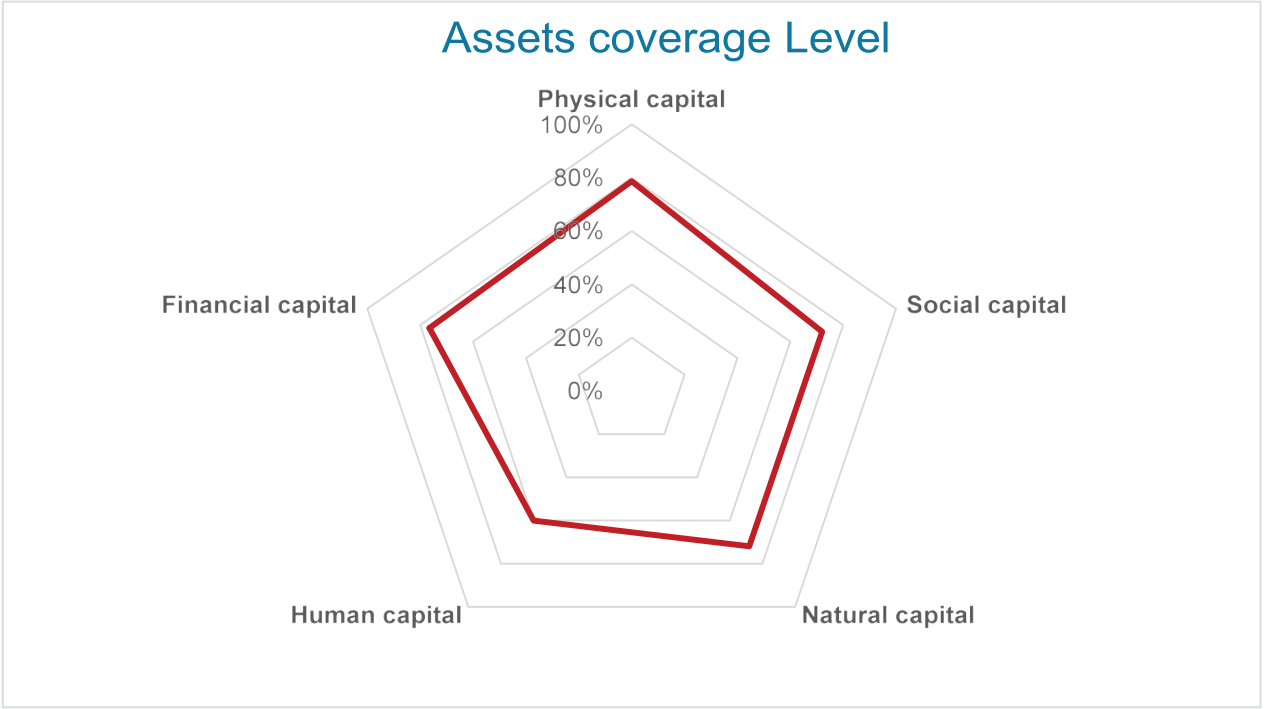


Figure 25: *Livelihood assets coverage for Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber.)*

Sustainable Livelihoods Analysis

The initiative shows robust **physical capital** with a 77% coverage, supported by quality land, irrigation, and inputs crucial for stress-tolerant vegetable cultivation in floodplains. **Social capital** stands at 70%, indicating moderate community trust and involvement, with room for improvement in collaborative efforts. **Natural capital**, at 66%, highlights challenges in land access, biodiversity impact, and climatic effects, necessitating better environmental practices. **Human capital** is at 65%, reflecting moderate education and health but requiring more investment in training and technology adaptation. Financial capital, with a 71% coverage, shows fair economic stability and access to resources, though further diversification and investment improvements are needed.

Overall Viability and Strategic Recommendations

Stress-tolerant vegetable cultivation in Zones 13, 18, and 2 shows strong potential with good physical and financial capital. To boost environmental sustainability, strategies for better biodiversity conservation and climate adaptability are needed. Enhancing social resilience through increased community engagement and support networks will further strengthen the initiative. Although economic stability is reasonable, improving financial literacy, diversifying income sources, and encouraging savings could offer more robust financial resilience. Addressing these areas through targeted improvements in natural, human, and social capitals will enhance the overall viability and sustainability of the cultivation system.

3.2.21 Sunflower cultivation

Sunflower cultivation operates within Zone 13 (Ganges Tidal Floodplain). This region is characterized by its extensive tidal land with smooth relief and significant areas of salinity.

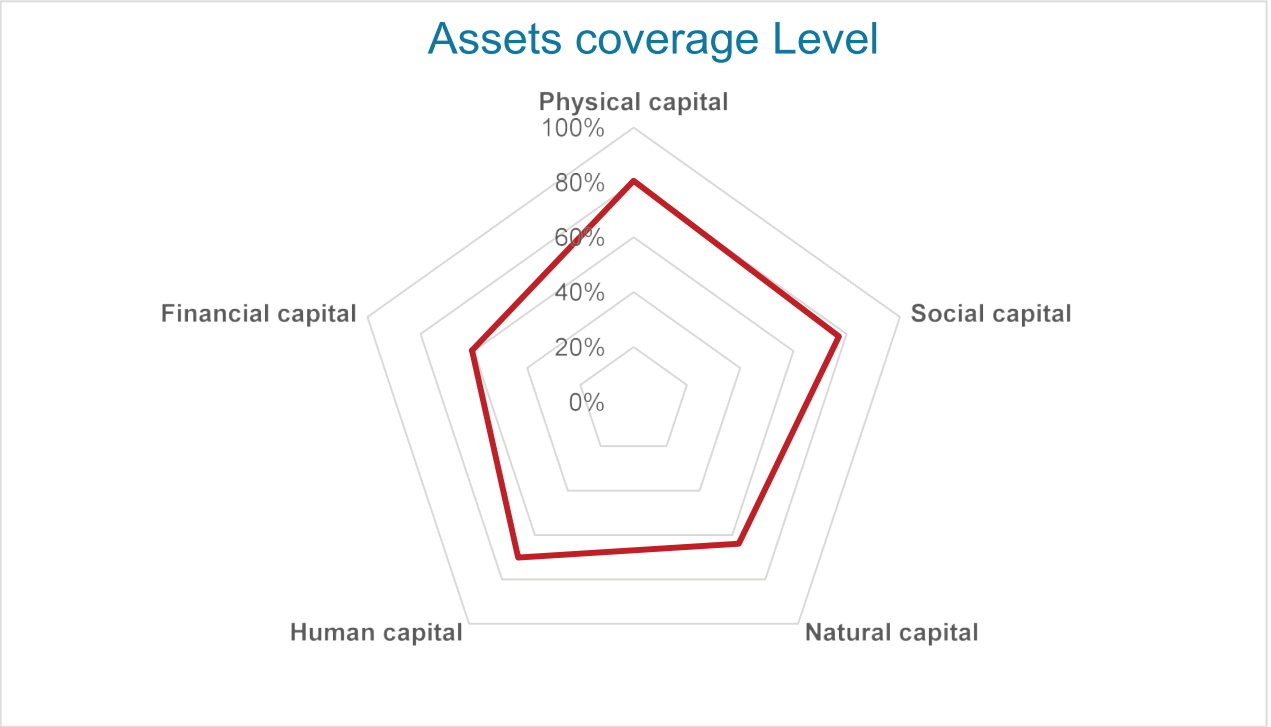


Figure 26: *Livelihood assets coverage for Sunflower Cultivation*

Sustainable Livelihoods Analysis

The sunflower cultivation initiative in Zone 13 demonstrates strong physical capital with 81% coverage, supported by good access to land, seeds, and fertilizers. Social capital is also robust at 77%, with high levels of trust and community involvement. However, natural capital coverage is moderate at 64%, with challenges in accessing resources and adapting to local climate conditions. Human capital stands at 70%, reflecting a reasonably educated and skilled workforce, though there's room for improvement in technology adaptation. Financial capital, at 61%, faces challenges, particularly in income stability and savings. Addressing these gaps will enhance the initiative's overall effectiveness and resilience.

Overall Viability and Strategic Recommendations

Sunflower cultivation in Zone 13 shows moderate environmental viability due to challenges like tidal flooding and soil salinity, but quality seeds and fertilizers help mitigate these issues. Social viability is strong, supported by high community trust and participation, though further development in disaster preparedness and climate adaptation is recommended. Economic viability is the weakest aspect, with financial capital at 61%; improving access to financial services and diversifying income sources are crucial. Overall, while the initiative has strong physical and social foundations, addressing natural and financial challenges through strategic interventions is essential for sustainable growth.

3.2.22 Vermicompost

Vermicompost operates within Zone 13 (Ganges Tidal Floodplain) and Zone 2 (Active Tista Floodplain) and focuses on utilizing organic waste materials to produce high-quality compost through the process of vermiculture, contributing to sustainable agriculture and enhancing soil fertility.

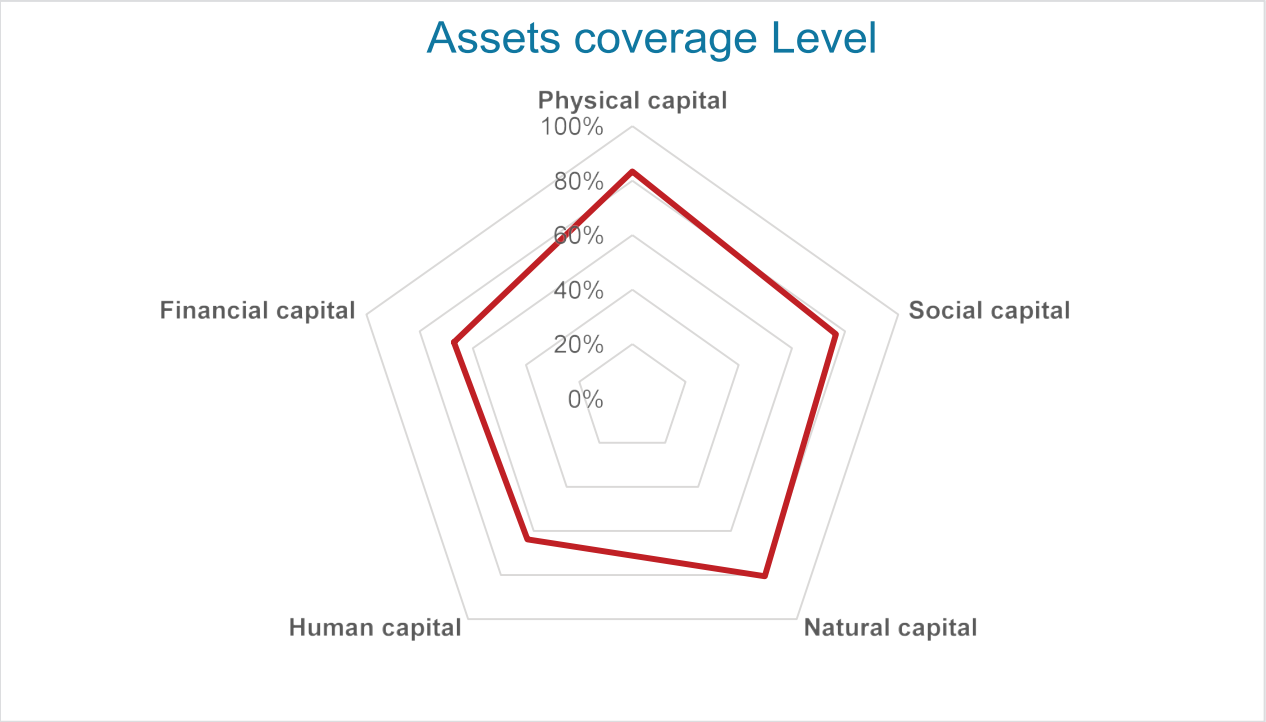


Figure 27: *Livelihood assets coverage for Vermicompost*

Sustainable Livelihoods Analysis

The Vermicompost initiative in Zones 13 and 2 exhibits strong physical capital with 83% coverage, effectively supporting compost production through ample resources and infrastructure. Social capital is also robust at 77%, fostering cooperation and community engagement. With 81% coverage in natural capital, the initiative demonstrates effective use of local resources and benefits biodiversity. However, human capital at 64% and financial capital at 67% indicate areas needing improvement in education, health, and financial access to enhance overall productivity and stability.

Overall Viability and Strategic Recommendations

The Vermicompost initiative in Zones 13 and 2 is strong in environmental sustainability and social resilience, effectively using organic waste to improve soil health and support biodiversity. The community's trust and cooperation further enhance its social viability. However, economic stability is moderate, with room for improvement in financial access and management. Enhancing human capital through better education and health services, alongside strengthening financial resources, will be crucial for maximizing the initiative's overall impact and sustainability.

3.2.23 Watermelon cultivation

Watermelon cultivation operates within Zone 13 (Ganges Tidal Floodplain), characterized by its unique geographical and climatic conditions which influence the cultivation practices and outcomes. The comprehensive analysis of the livelihood capitals provides insights into the strengths and areas for improvement in watermelon cultivation.

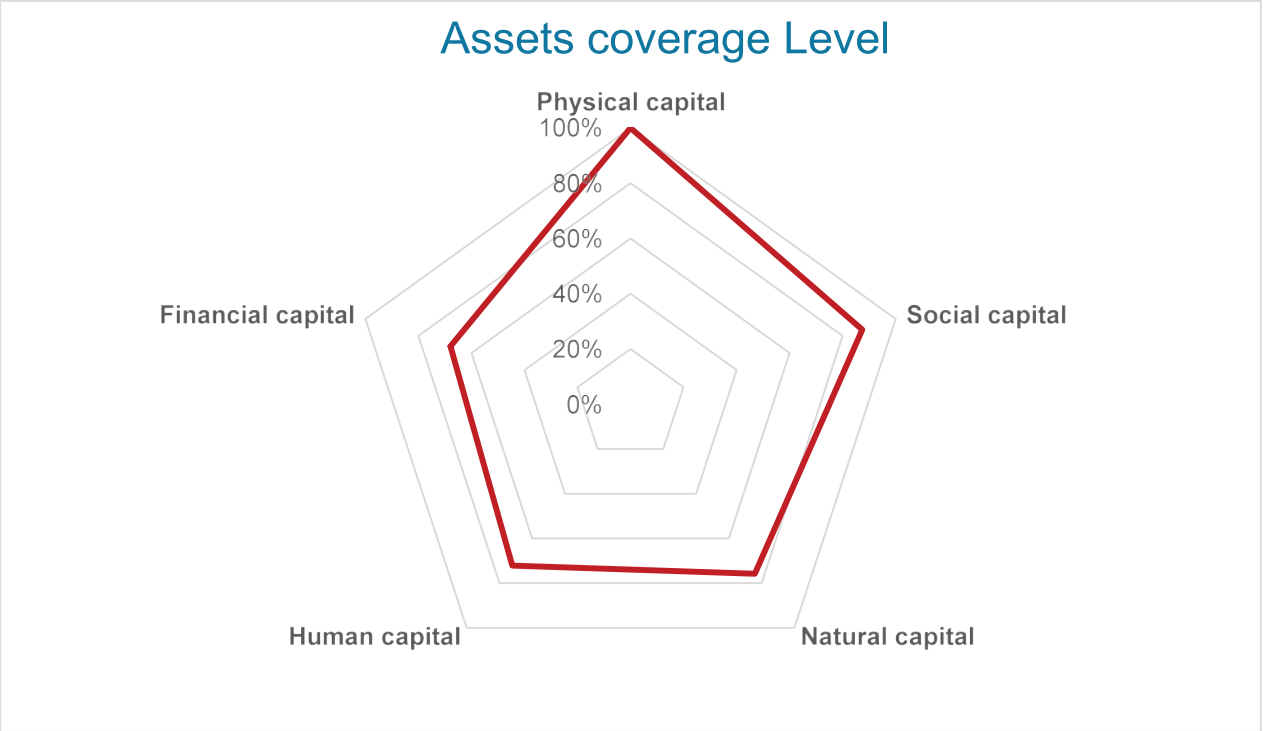


Figure 28: *Livelihood assets coverage for Watermelon cultivation*

Sustainable Livelihoods Analysis

The Watermelon cultivation initiative has strong physical capital with 81% coverage, supported by key resources like land access and quality inputs. Social capital is moderately robust at 77%, though improvements in community cooperation and decision-making are needed. Natural capital is at 64%, indicating adequate but improvable resource availability and climate resilience. Human capital stands at 70%, showing satisfactory education and skills but requiring enhanced health and training programs. Financial capital is weaker at 61%, highlighting a need for better financial access and planning. Overall, while the initiative has a solid foundation, focused improvements in social, natural, human, and financial capitals are necessary for enhanced sustainability and productivity.

Overall Viability and Strategic Recommendations

Watermelon cultivation in Zone 13 is moderately sustainable, with effective use of land, water, and inputs, but requires better biodiversity protection and climate resilience. The initiative benefits from strong community trust and participation, though enhancing social interactions and cooperative frameworks is needed. Economic stability is challenged by limited financial resources, necessitating improved financial access, microloans, and income diversification. Overall, while physical and social capitals are strong, significant improvements in natural, human, and financial capitals are needed to enhance sustainability and resilience in the Ganges Tidal Floodplain.

3.3 Marketability of CALOs

The marketability of CALOs is assessed in this study. The primary importance of analyzing CALO's marketability is to ensure that these options are economically viable for the communities adopting them. This analysis helps determine whether there is a demand for the products or services generated through CALO, whether these can compete in the market, and if they can provide sustainable income streams to those who adopt them. Understanding the marketability of CALO can also support advocacy efforts for policies that facilitate climate adaptation. It provides concrete data to policymakers about the benefits and potential economic impacts of supporting and scaling such options, leading to more informed and effective policy decisions. Analyzing the marketability of Climate Adaptive Livelihood Options is essential not just for the success of these initiatives but also for the broader goal of building resilient, adaptive communities in the face of climate challenges.

In order to assess marketability, this study has used PESTEL framework. Due to the nature of the study, the data for PESTEL analysis has been collected from both quantitative and qualitative interviews. The economic and technological aspects of marketability have been addressed with quantitative survey and political, legal, social, and environmental aspects are addressed with secondary data and qualitative interviews. This study has drawn conclusions on marketability by triangulating qualitative, quantitative and secondary data.

3.3.1 Economic and Technological Aspects of CALO Marketability

Using the data from quantitative survey, a scale is developed to assess the marketability of CALO considering the economic and technological aspects of PESTEL framework. A total of 13 items were used in the scale. Each item consists of 5 response options in a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

The 13 items used are as follows:

1. You can access the market easily to sell your CALO products.
2. It is not difficult for you to find buyers for your CALO products.
3. You have been able to sell your CALO products in more places or to more people than before
4. You feel that CALO activities are financially stable in the long term.
5. There are no financial risks involved with CALO.
6. People want to buy more of what you grow or make with CALO than before
7. Very often, you run out of stock because of high demand for your CALO products.
8. You believe that your CALO products are selling faster.
9. The technologies introduced with CALO are suitable for people like yours
10. Technological advancements from CALO have been affordable for you and your community.
11. The new technologies have been very effective in improving your farms' productivity.
12. The adoption of new technologies led to better disease management on your farm.
13. New technologies can make CALO more profitable.

For each CALO, the attained score against each of the item of the scale was summed to get a total

score for that CALO. The scale ranged from a minimum possible value of 13 to maximum possible value of 65. This continuous scale was converted into 3 categories based on “Equal Interval Binning Technique”. This approach resulted into the following categories:

- Low Category: This category ranges from score 13 to 30.3
- Medium Category: This category ranges from score 30.4 to 47.6
- High Category: This category ranges from score 47.7 to 65

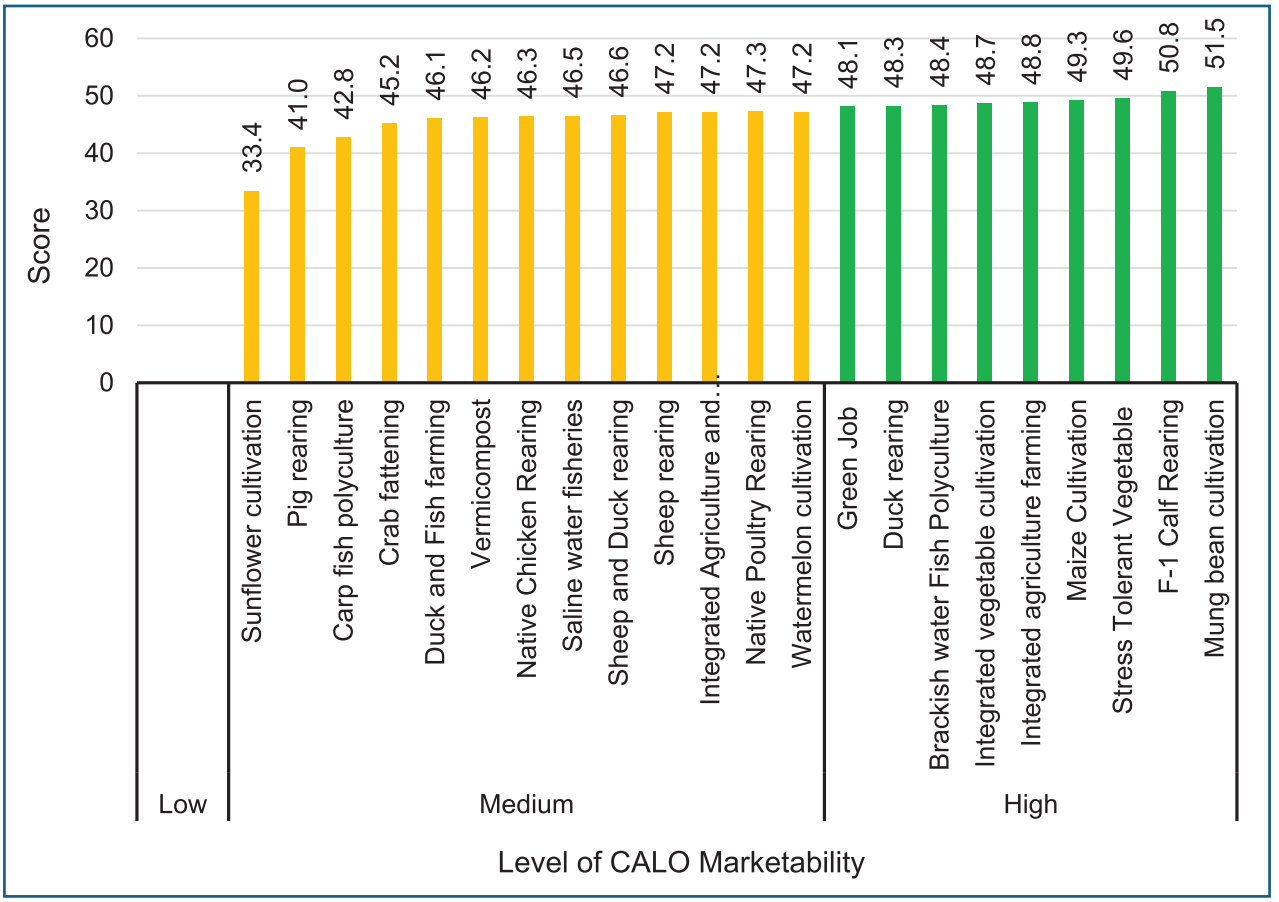


Figure 29: *Distribution of the CALO marketability score by the categories of CALO (N=1011)*

The figure above illustrates distribution of level of CALO marketability across different CALOs. The overall findings show that, there is no CALO falling into the “Low” category where majority of the CALOs are in the medium level of marketability and the others having high level of marketability. Each CALOs are discussed considering their score attained and their strength and weakness in the following:

Sunflower Cultivation

Total Score: 33.4 (Medium Marketability; lowest score among all other CALOs in medium category)

Sunflower cultivation received its highest scores (3.9) for "It is not difficult for you to find buyers for your CALO products" and "You believe that your CALO products are selling faster." However, the lowest scores (1.8) were for "Very often, you run out of stock because of high demand for your CALO products," indicating significant challenges in meeting high demand and accessing markets, which impacts its overall marketability.

Pig Rearing

Total Score: 41.0 (Medium Marketability)

Pig rearing received its highest scores (3.8) for the statements "The new technologies have been very effective in improving your farms productivity," "The adoption of new technologies led to better disease management on your farm," and "New technologies can make CALO more profitable." This indicates a strong belief in the benefits of new technologies for productivity, disease management, and profitability. The lowest scores (2.0) were given for "You believe that your CALO products are selling faster", highlighting challenges in the pace of product sales.

Carp Fish Polyculture

Total Score: 42.8 (Medium Marketability)

Carp fish polyculture scored highest (3.4) on several statements: "You can access market easily to sell your CALO products," "It is not difficult for you to find buyers for your CALO products," "You have been able to sell your CALO products in more places or to more people than before," "You believe that your CALO products are selling faster," and "The technologies introduced with CALO are suitable for people like yours." This suggests strong market access and technological suitability. The lowest score (3.1) was given for "You feel that CALO activities are financially stable in the long term," "There are no financial risks involved with CALO," and "Technological advancements from CALO have been affordable for you and your community," indicating concerns in financial stability and affordability of technology.

Crab Fattening

Total Score: 45.2 (Medium Marketability)

Crab fattening received its highest score (4.0) for the statements "You can access market easily to sell your CALO products," "You have been able to sell your CALO products in more places or to more people than before," and "People want to buy more of what you grow or make with CALO than before." This indicates that crab fattening is perceived to have strong market access and demand. The lowest score (2.5) was given for the statement "There are no financial risks involved with CALO," suggesting concerns about financial risks associated with this livelihood option.

Duck and Fish Farming

Total Score: 46.1 (Medium Marketability)

Duck and fish farming scored highest (4.0) for "You can access market easily to sell your CALO products," reflecting good market access. The lowest scores (3.0) were for "There are no financial risks involved with CALO" and "Technological advancements from CALO have been affordable for you and your community," indicating concerns about financial risks and affordability of technology.

Vermicompost

Total Score: 46.2 (Medium Marketability)

Vermicompost received its highest scores (4.0) for "There are no financial risks involved with CALO" and "New technologies can make CALO more profitable," indicating perceived financial stability and profitability potential. The lowest scores (3.3) were for "People want to buy more of what you grow or make with CALO than before" and "Very often, you run out of stock because of high demand for your CALO products," indicating some challenges in increasing demand and meeting high demand.

Native Chicken Rearing

Total Score: 46.3 (Medium Marketability)

Native chicken rearing received its highest scores (3.9) for "You can access market easily to sell your CALO products," "You have been able to sell your CALO products in more places or to more people than before," and "People want to buy more of what you grow or make with CALO than before." This suggests strong market access and demand. The lowest score (3.2) was for "Technological advancements from CALO have been affordable for you and your community," indicating some concerns about the affordability of technological advancements.

Saline Water Fisheries

Total Score: 46.5 (Medium Marketability)

Saline water fisheries received its highest scores (4.0) for "You can access market easily to sell your CALO products," "You have been able to sell your CALO products in more places or to more people than before," and "Very often, you run out of stock because of high demand for your CALO products," suggesting strong market access and high demand. The lowest score (2.8) was for "Technological advancements from CALO have been affordable for you and your community," indicating significant concerns about the affordability of technological advancements.

Sheep and Duck Rearing

Total Score: 46.6 (Medium Marketability)

Sheep and duck rearing received its highest scores (3.9) for "You can access market easily to sell your CALO products" and "There are no financial risks involved with CALO," suggesting good market access and perceived financial stability. The lowest score (3.1) was for "The new technologies have been very effective in improving your farms productivity," indicating concerns about the effectiveness of new technologies in enhancing productivity.

Sheep Rearing

Total Score: 47.2 (Medium Marketability)

Sheep rearing received the highest scores (3.9) for the statements "You can access market easily to sell your CALO products," "You have been able to sell your CALO products in more places or to more people than before," and "You feel that CALO activities are financially stable in the long term." This reflects strong market access and financial stability perceptions. The lowest score (3.0) was given for the statements "You believe that your CALO products are selling faster".

Integrated Agriculture and Poultry

Total Score: 47.2 (Medium Marketability)

Integrated agriculture and poultry received its highest scores (4.0) for the statements "You can access market easily to sell your CALO products," indicating strong market access. The lowest score (3.3) was for "Very often, you run out of stock because of high demand for your CALO products," suggesting some challenges in meeting high demand.

Native Poultry Rearing

Total Score: 47.3 (Medium Marketability)

Native poultry rearing received its highest scores (3.9) for "You can access market easily to sell your CALO products," "You feel that CALO activities are financially stable in the long term," and "People want to buy more of what you grow or make with CALO than before." This indicates good market access, financial stability, and demand. The lowest score (2.7) was for "Very often, you run out of stock because of high demand for your CALO products," suggesting some challenges in meeting high demand.

Watermelon Cultivation

Total Score: 47.2 (Medium Marketability)

Watermelon cultivation received the highest scores (3.8) for several statements: "You have been able to sell your CALO products in more places or to more people than before," "There are no financial risks involved with CALO," "People want to buy more of what you grow or make with CALO than before," and "Very often, you run out of stock because of high demand for your CALO products." This indicates good market access and demand. The lowest score (3.4) was for "The technologies introduced with CALO are suitable for people like yours," suggesting concerns about the suitability and affordability of technology.

Green Job (Bamboo-based Handicraft)

Total Score: 48.1 (High Marketability)

Green job (bamboo-based handicraft) scored highest (4.0) for "You have been able to sell your CALO products in more places or to more people than before," "People want to buy more of what you grow or make with CALO than before," and "There are no financial risks involved with CALO," indicating strong market access, demand, and financial stability. The lowest score (2.9) was for "Very often, you run out of stock because of high demand for your CALO products," indicating challenges in meeting high demand.

Duck Rearing

Total Score: 48.2 (High Marketability)

Duck rearing received its highest scores (3.9) for "You can access market easily to sell your CALO products," "You have been able to sell your CALO products in more places or to more people than before," "There are no financial risks involved with CALO," suggesting strong market access, demand, and financial stability. The lowest score (3.3) was for "Very often, you run out of stock because of high demand for your CALO products," indicating challenges in meeting high demand.

Brackish Water Fish Polyculture

Total Score: 48.4 (High Marketability)

Brackish water fish polyculture received its highest scores (4.0) for the statements "You can access market easily to sell your CALO products," "You have been able to sell your CALO products in more places or to more people than before," and "New technologies can make CALO more profitable." This suggests excellent market access, broad distribution, and profitability potential. The lowest score (3.1) was for "Very often, you run out of stock because of high demand for your CALO products," indicating some challenges in meeting high demand.

Integrated Vegetable Cultivation

Total Score: 48.7 (High Marketability)

Integrated vegetable cultivation received its highest scores (4.1) for the statements "You can access market easily to sell your CALO products," "You have been able to sell your CALO products in more places or to more people than before," "You believe that your CALO products are selling faster,". This suggests excellent market access, broad distribution, and high demand. The lowest score (3.3) was for "Technological advancements from CALO have been affordable for you and your community," indicating some concerns about technology affordability.

Integrated Agriculture Farming

Total Score: 48.8 (High Marketability)

Integrated agriculture farming received its highest scores (4.0) for "You can access market easily to sell your CALO products," suggesting excellent market access and demand. The lowest score (3.4) was for "Technological advancements from CALO have been affordable for you and your community," indicating some concerns about technology affordability.

Maize Cultivation

Total Score: 49.3 (High Marketability)

Maize cultivation received its highest scores (4.0) for "You can access market easily to sell your CALO products," "You feel that CALO activities are financially stable in the long term," and "People want to buy more of what you grow or make with CALO than before," indicating excellent market access, financial stability, and demand. The lowest score (3.1) was for "Very often, you run out of stock because of high demand for your CALO products," indicating challenges in meeting high demand.

Stress-Tolerant Vegetable Cultivation

Total Score: 49.6 (High Marketability)

Stress-tolerant vegetable cultivation received its highest score (4.1) for "You can access market easily to sell your CALO products," This indicates excellent market access and high demand. The lowest score (3.1) was for "Technological advancements from CALO have been affordable for you and your community," suggesting some concerns about the affordability of technological advancements.

F-1 Calf Rearing

Total Score: 50.8 (High Marketability)

F-1 calf rearing received its highest scores (4.0) for "You can access market easily to sell your CALO products," "You feel that CALO activities are financially stable in the long term," "You believe that your CALO products are selling faster," "The technologies introduced with CALO are suitable for people like yours," "Technological advancements from CALO have been affordable for you and your community," "The new technologies have been very effective in improving your farms productivity," "The adoption of new technologies led to better disease management on your farm," and "New technologies can make CALO more profitable." This indicates excellent market access, financial stability, demand, and technological suitability and affordability. The lowest score (3.5) was for "It is not difficult for you to find buyers for your CALO products," suggesting some challenges in finding buyers.

Mung Bean Cultivation

Total Score: 51.5 (High Marketability)

Mung bean cultivation received the highest scores (4.3) for "You can access market easily to sell your CALO products," and "You believe that your CALO products are selling faster." indicating strong market access, high demand, and perceived financial stability. The lowest score (3.5) was for "Technological advancements from CALO have been affordable for you and your community," indicating some concerns about the affordability of technological advancements.

The evaluation of 22 Climate Adaptive Livelihood Options (CALOs) provides a comprehensive view of their marketability based on various criteria. High marketability CALOs, scoring above 47.7, include mung bean cultivation, F-1 calf rearing, maize cultivation, stress-tolerant vegetable cultivation, integrated agriculture farming, and green job (bamboo-based handicraft). These CALOs exhibit strong market access, high demand, financial stability, and suitability of technological advancements. For instance, mung bean cultivation and F-1 calf rearing excel in market access and

product sales speed, while stress-tolerant vegetable cultivation and integrated agriculture farming show excellent market distribution and demand. On the other hand, CALOs with medium marketability, scoring between 30.4 to 47.6, include crab fattening, carp fish polyculture, sheep rearing, pig rearing, integrated agriculture and poultry, duck and fish farming, watermelon cultivation, vermicompost, saline water fisheries, sheep and duck rearing, brackish water fish polyculture, native poultry rearing, native chicken rearing, and integrated vegetable cultivation. These CALOs demonstrate good potential but face challenges such as technological affordability and meeting high demand. For example, crab fattening and carp fish polyculture show strong market access but have concerns about financial risks and technology affordability, while native poultry rearing, and brackish water fish polyculture indicate strong demand but struggle with meeting high demand consistently. Overall, the high marketability CALOs are well-positioned to capitalize on their strengths in market access and technological suitability, while medium marketability CALOs can benefit from targeted support to address their specific challenges.

Benefit-Cost Analysis

The study conducted Benefit-Cost Analysis (BCA) to evaluate the economic pros and cons of the CALOs by comparing the total expected costs against the total expected benefits. The methodology involves identifying and quantifying all relevant costs and benefits in monetary terms, discounting future values to present terms, and then summing these values to determine the net benefit or cost. The scoring approach typically involves calculating a Benefit-Cost Ratio (BCA), which is the ratio of the total benefits to the total costs. A BCA greater than 1 indicates that benefits outweigh costs, making the project economically viable, while a BCA less than 1 suggests the opposite. A higher BCA indicates a more profitable CALO relative to its costs. Here's an analysis of the trends and insights from the figures:

It is mentionable that the study aimed to collect and analyze data for various CALOs over the period from 2020 to 2023. However, the duration of data available for each CALO varies. Some CALOs have four years of data, while others have data for three years, two years, or only one year. Consequently, the analysis was conducted separately for CALOs with the same duration of data to ensure accuracy and relevance. This approach allows for a more precise evaluation of each CALO's performance over its respective operational period, facilitating a fair comparison and reliable insights into their profitability and sustainability.

CALOs with four years of operation

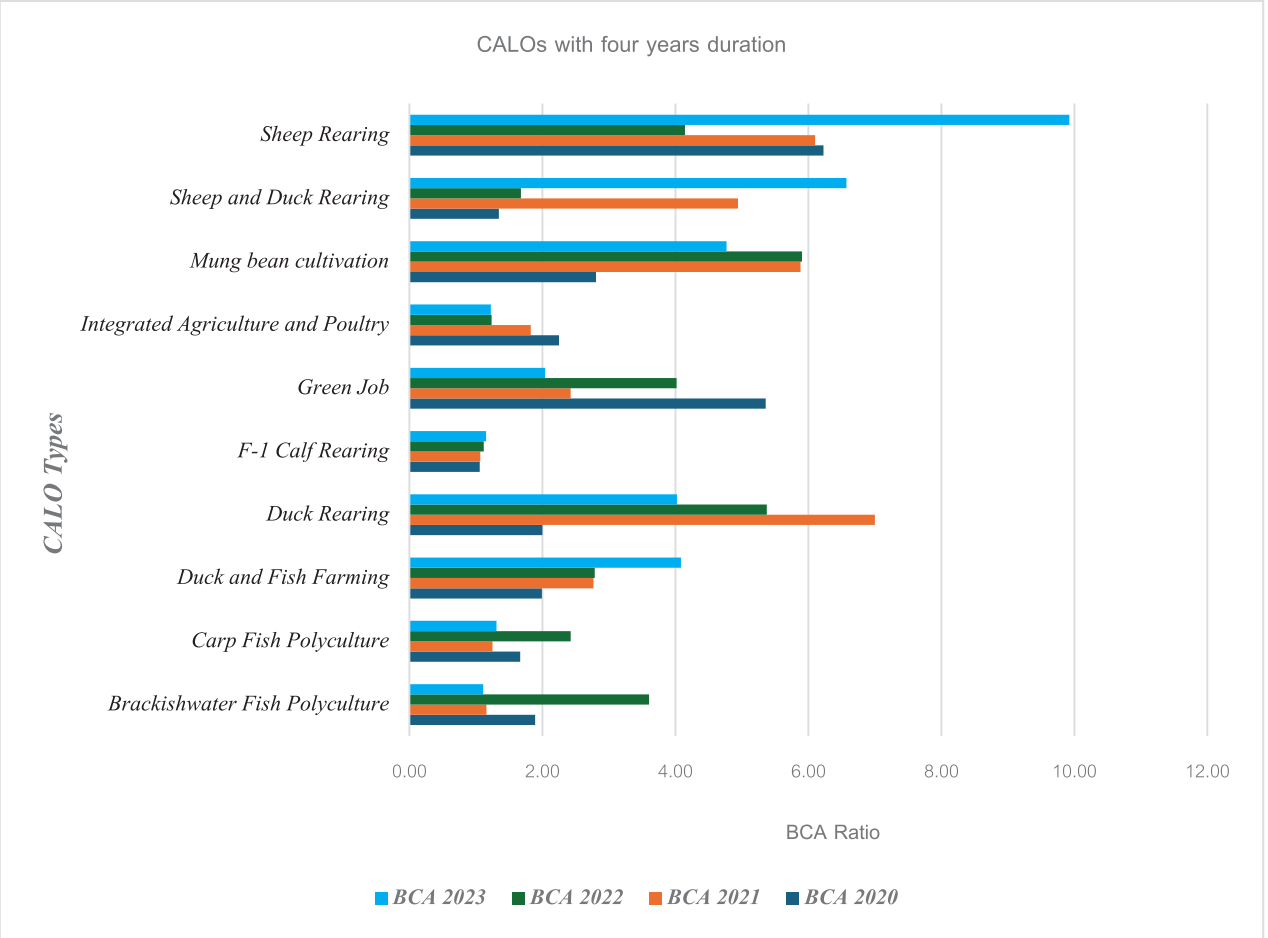


Figure 28: *BCA ratio of CALOs with four years in operation*

The analysis of BCA for various CALOs over the years reveals distinct performance trends. Consistently high performers include sheep rearing, with BCA increasing from 6.23 in 2020 to 9.92 in 2023, and mung bean cultivation, with BCAs ranging from 2.81 in 2020 to 4.77 in 2023, peaking at 5.90 in 2022. Duck rearing shows significant variability, peaking at 7.00 in 2021 but decreasing to 4.02 in 2023, while green jobs fluctuate from 5.36 in 2020 to 2.04 in 2023. Duck and fish farming show improvement, with BCA rising from 1.99 in 2020 to 4.08 in 2023, and sheep and duck rearing increasing from 1.35 in 2020 to 6.57 in 2023. However, underperforming CALOs like F-1 calf rearing maintain low BCAs around 1.06-1.15, and integrated agriculture and poultry show a decreasing trend from 2.25 in 2020 to 1.22 in 2023. Fluctuating performers include brackish water fish polyculture, with variability from 1.89 in 2020 to 1.11 in 2023, and carp fish polyculture, with BCAs ranging from 1.67 in 2020 to 1.31 in 2023.

Recommendations:

1. Focus on High Performers: Investments should prioritize consistently high-performing CALOs like sheep rearing and mung bean cultivation to maximize returns.
2. Monitor and Support Variable Performers: CALOs with fluctuating BCAs, such as duck rearing and green jobs, may need targeted support to stabilize and enhance their profitability.

3. Reassess Underperforming CALOs: CALOs like F-1 calf rearing and integrated agriculture and poultry might require a reevaluation of their models or additional support to improve their cost-effectiveness.

4. Encourage Emerging Profitable CALOs: Continue supporting CALOs that show significant improvement, such as sheep and duck rearing and duck and fish farming, to sustain and boost their growth trajectories.

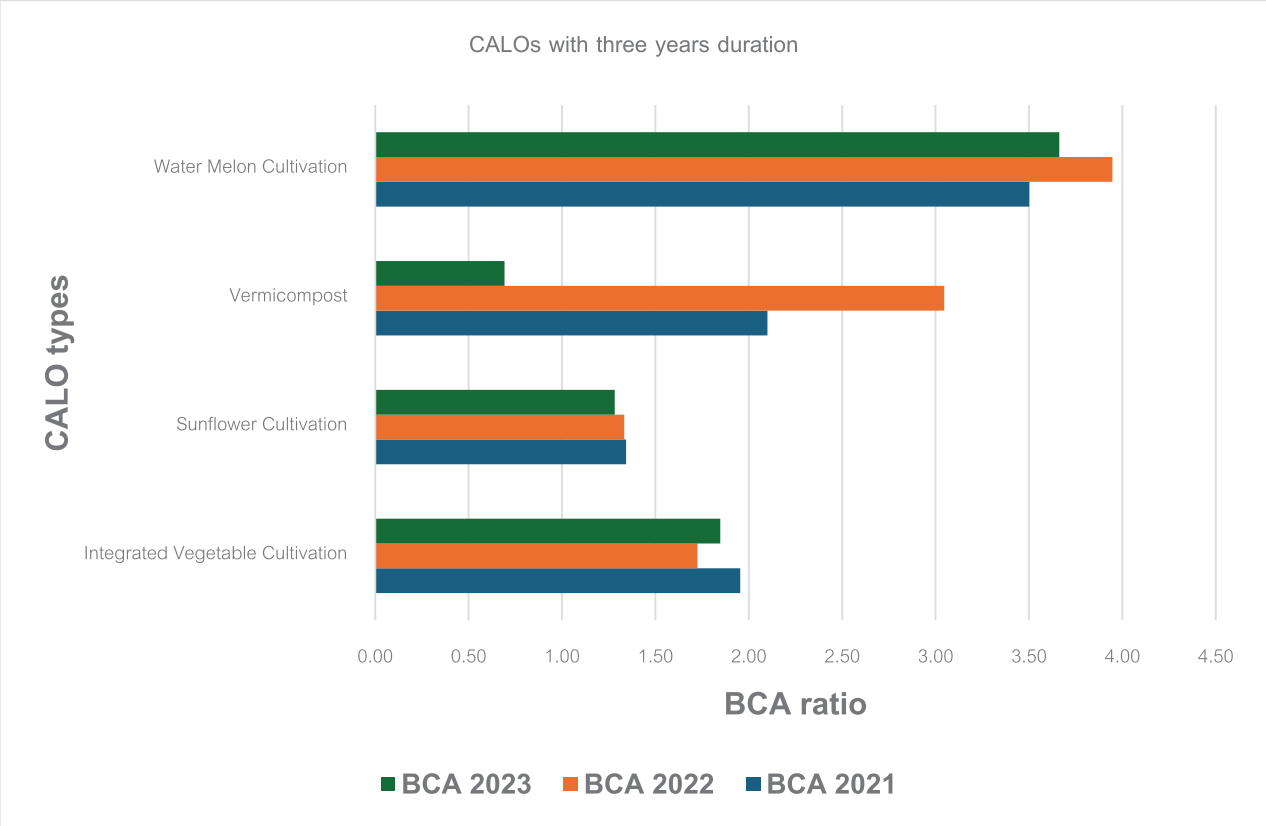


Figure 29: *BCA ratio of CALOs with three years in operation*

CALOs with Three years in operation

The analysis of the BCA for various CALOs over three years reveals distinct performance trends. Watermelon cultivation stands out as a consistently high performer, with a BCA starting at 3.50 in 2021, increasing to 3.95 in 2022, and slightly decreasing to 3.66 in 2023, indicating it is a reliable and profitable option. Integrated vegetable cultivation, categorized as a moderately stable performer, shows relatively stable BCAs with minor fluctuations, starting at 1.95 in 2021, slightly decreasing to 1.73 in 2022, and recovering to 1.85 in 2023, suggesting moderate profitability. In contrast, sunflower cultivation is a declining performer, displaying a slight but steady decline in BCA from 1.34 in 2021 to 1.28 in 2023, indicating a decreasing trend in profitability, though the changes are relatively small. Vermicompost shows significant variability, with a BCA of 2.10 in 2021, peaking at 3.05 in 2022, and then dropping sharply to 0.69 in 2023, suggesting its profitability is highly variable and may be influenced by external factors or operational inconsistencies.

Recommendations:

1. Focus on High Performers: Continued investment in watermelon cultivation is advisable due to its consistently high and stable BCA.

2. Monitor and Support Stable Performers: Integrated vegetable cultivation shows promise but might benefit from targeted interventions to further stabilize and enhance profitability.

3. Reassess Declining CALOs: Sunflower cultivation's declining trend should be investigated to identify and address underlying issues affecting profitability. The sustainable livelihood analysis suggests that the financial capital is relatively weak for Sunflower cultivation. The in-depth analysis shows factors like “Access to loans” (score of 2.5), “access to other financial services” (score of 2.83), and “the viability of savings from CALO income” (score of 1.21) and “investments from CALO income” (score of 1.08) require targeted focus.

For all the declining CALOs, engagement with financial institutions to understand their loan products and negotiate favorable terms for beneficiaries is vital. Conducting outreach and educational programs to inform farmers about available loan options and how to apply for them could also be considered. It is also recommended to provide advisory services to help farmers identify profitable investment opportunities within the agricultural sector, such as purchasing better seeds, fertilizers, or farming equipment.

4. Stabilize Variable Performers: Vermicompost requires a detailed analysis to understand the causes of its significant BCA drop in 2023. Interventions to stabilize and improve its profitability should be considered.

CALOs with two years in operation

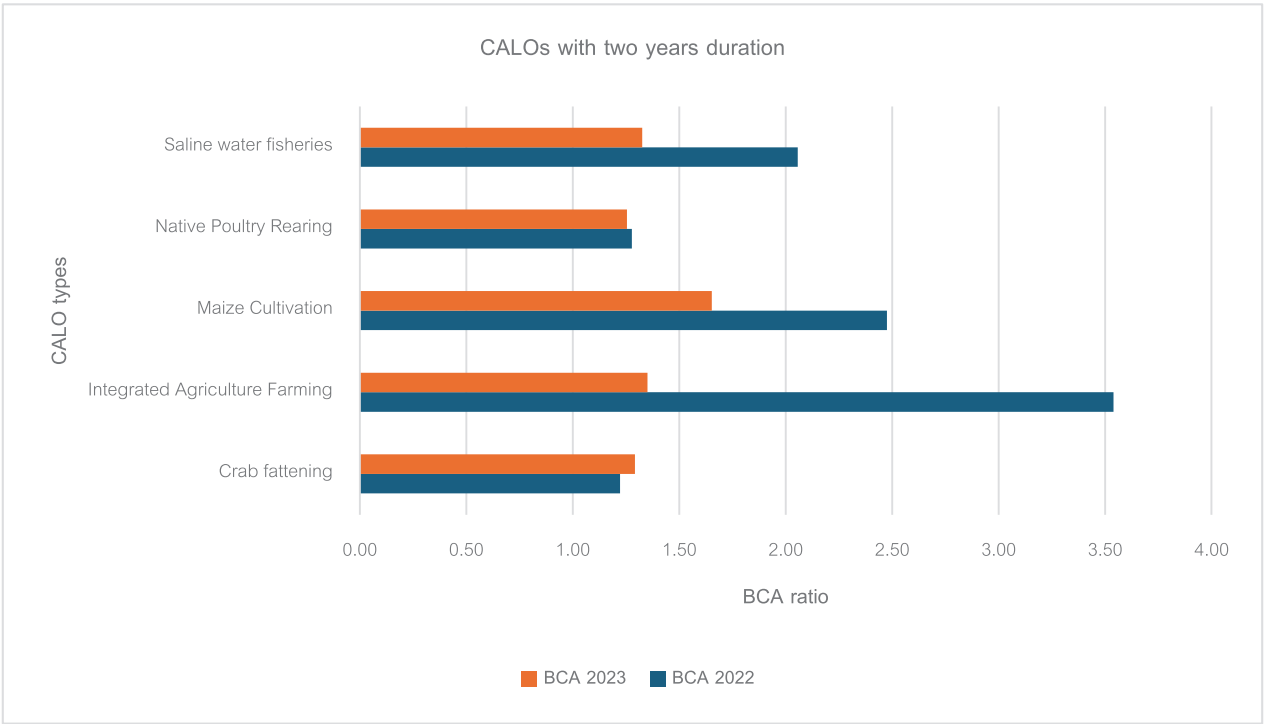


Figure 30: *BCA ratio of CALOs with two years in operation*

The analysis of the BCA for various CALOs over two years reveals several performance trends. Declining performers include integrated agriculture farming, which shows a significant decrease in BCA from 3.54 in 2022 to 1.35 in 2023, indicating a sharp reduction in profitability likely due to operational challenges or external factors. Similarly, maize cultivation experiences a notable drop in BCA from 2.48 in 2022 to 1.65 in 2023, reflecting a decline in profitability. Stable or slightly improving performers include crab fattening, which shows a slight improvement in BCA from 1.22 in 2022 to 1.29 in 2023, indicating a marginal increase in profitability but remaining relatively low overall, and native poultry rearing, which displays a slight decrease in BCA from 1.28 in 2022 to 1.25 in 2023, suggesting stable profitability with minor fluctuations. Saline water fisheries experience a significant decline, with a BCA dropping from 2.06 in 2022 to 1.33 in 2023, indicating a considerable reduction in profitability potentially due to changes in environmental conditions or market dynamics.

Recommendations:

1. **Address Declining CALOs:**

- Integrated agriculture farming and maize cultivation require investigation to identify the factors contributing to their significant decline in profitability. Potential interventions could include improving agricultural practices, providing better access to markets, or addressing external challenges.
- Saline water fisheries should also be examined to determine the causes of the reduced BCA and to implement strategies to enhance profitability.

2. **Support Stable or Slightly Improving CALOs:**

- Crab fattening, which shows a slight improvement, may benefit from continued support and optimization of current practices to further increase its profitability.
- Native poultry rearing, despite slight fluctuations, remains relatively stable and may require minor adjustments to maintain or slightly improve profitability.

CALOs with one year of operation

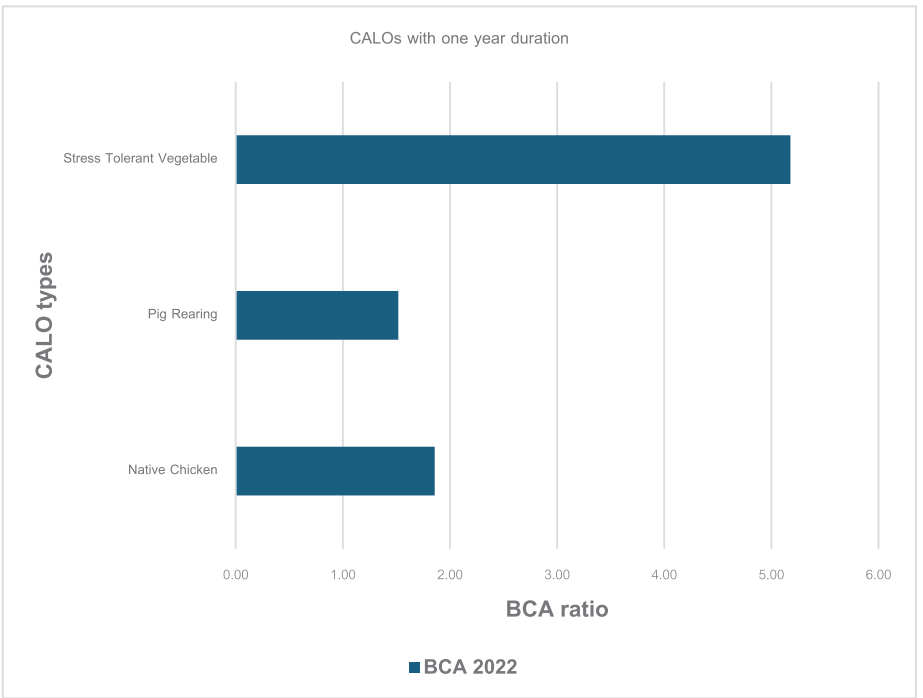


Figure 31: *BCA ratio of CALOs with one year in operation*

The analysis of the BCA for various CALOs over one-year highlights distinct performance levels. Stress-tolerant vegetable cultivation stands out as a high performer with a BCA of 5.18, indicating a strong return on investment. This suggests that stress-tolerant vegetables are highly profitable and resilient, likely due to their ability to withstand adverse conditions and potentially high market demand. Among the moderate performers, native chicken rearing shows a BCA of 1.86, indicating a reasonable level of profitability and suggesting it can be a viable livelihood option with a good return on investment, though not as high as stress-tolerant vegetables. Pig rearing, with a BCA of 1.52, is also a profitable option, albeit with a lower return on investment compared to stress-tolerant vegetables and native chicken. This indicates that while pig rearing is a viable option, it may require more support to enhance profitability.

Recommendations:

1. Encourage High Performers:

- Given the high BCA of stress-tolerant vegetable cultivation, efforts should be made to promote and expand this CALO. Providing additional resources, training, and support could further enhance its profitability and scalability.

2. Support Moderate Performers:

- Native chicken rearing shows promise as a profitable venture. Continued support in terms of better feed, healthcare, and market access could help increase its profitability.
- Pig rearing, while profitable, could benefit from targeted interventions to boost efficiency and reduce costs. Support in areas like veterinary care, feed quality, and market linkages could improve its BCA.

3. Monitor and Optimize:

- Regular monitoring and evaluation of these CALOs should be conducted to identify areas for improvement and ensure sustained profitability. This includes tracking market trends, cost factors, and productivity levels.

Combined analysis of marketability and BCA across the CALOs

The analysis of the 22 Climate Adaptive Livelihood Options (CALOs) presents a comprehensive view of their marketability and economic viability based on marketability scores and Benefit Cost Analysis (BCA) results. Each CALO is analyzed considering both aspects to determine their potential success and challenges in the market.

High Marketability and High BCA:

Stress Tolerant Vegetable Cultivation and Mung Bean Cultivation stand out with high marketability and BCA scores, indicating robust market demand and substantial financial returns. These CALOs are well adapted to current market demands and technological advancements. Crab Fattening and Carp Fish Polyculture also demonstrate strong marketability and profitability, suggesting they are well established in the market with effective operational strategies.

Medium Marketability with Variable BCA:

Pig Rearing, Duck and Fish Farming, and Sheep Rearing show moderate marketability. While generally profitable, Pig Rearing has a lower BCA, indicating some inefficiencies that might affect its financial sustainability. Integrated Agriculture and Poultry exhibits moderate marketability with a positive BCA, pointing to stable profitability despite fluctuating market conditions.

High Marketability but Lower BCA:

F1 Calf Rearing and Maize Cultivation are highly marketable but have lower BCA scores. This discrepancy suggests high market access but reduced profitability, possibly due to high costs or inefficiencies.

Emerging CALOs with Improving BCAs:

Watermelon Cultivation and Integrated Vegetable Cultivation have improved BCAs, indicating potential growth in profitability and marketability with continued support and adaptation.

Underperforming in Marketability and BCA:

Sunflower Cultivation and Vermicompost struggle with both marketability and BCA scores. These CALOs face external challenges that impact on their market performance and profitability, necessitating strategic interventions.

Specialized Market Niches:

Green Jobs (Bamboo based Handicrafts) and Saline Water Fisheries score well in marketability but face distinct challenges. Green Jobs, while appealing, struggles with broad market acceptance due to its niche appeal. Conversely, Saline Water Fisheries show promise in specialized markets, benefiting from targeted demand.

In conclusion, while many CALOs are promising in terms of market success and economic viability, the level of success varies widely. High performing CALOs benefit from strong market demand and advanced technological support, whereas others require strategic adjustments and enhanced support mechanisms to improve their market alignment and operational efficiency. The analysis suggests focusing on enhancing technological adaptability, market access, and addressing specific operational challenges to elevate the overall performance of CALOs.

3.3.2 Political & Legal Aspects of CALO Marketability

Political support is crucial for the proliferation of CALOs, as it determines the prioritization and allocation of resources towards adaptive practices. Governments that recognize the importance of adapting to climate change often provide subsidies, incentives, and support for research and development in CALOs. Legally, the framework surrounding CALOs involves regulations and laws that govern land use, water rights, seed and breed rights, and environmental protection. Effective legal structures that support the rights of smallholders and local communities enhance the adoption of CALOs by providing security and reducing risk for investors and farmers alike.

Utilizing secondary and qualitative data, this section discusses government level policies, actions that are either promoting successful implementation of CALO or creating hurdles.

Policy Level actions on Livestock Rearing: The Bangladesh government has a comprehensive National Livestock Development Policy in place . This policy aims to ensure the supply of adequate livestock and livestock products for human consumption and to increase the supply of animal power and animal waste for crop production and product processing. The policy covers various aspects of livestock development, including dairy development, meat production, poultry development, veterinary services, animal health, feeds and fodder management, breeds development, marketing of livestock products, and access to credit and insurance. This policy can significantly help livestock related CALOs such as Sheep rearing, Pig rearing, Duck rearing, Native Poultry Rearing, Native Chicken Rearing, F-1 Calf Rearing, Sheep and Duck rearing by providing access to veterinary services, quality feeds and fodder, improved breeds, and marketing support for livestock products. It also facilitates access to credit and insurance, which can help individuals manage risks and invest in their livestock businesses.

Policy Level Actions on Aquaculture: The National Aquaculture Development Strategy and Action Plan of Bangladesh (2013–2020) outlines the government's commitment to the sustainable development of the aquaculture sector. This policy can help aquaculture related CALOs like Crab fattening, Carp fish polyculture, Duck and Fish farming, Saline water fisheries, Brackishwater Fish by promoting the welfare of resource-poor people, poverty reduction, sustainable development of rural communities, food security, livelihood security, employment, and better nutrition. The government's approval of the National Fisheries Policy and the National Fisheries Strategy, which include Aquaculture and Aquaculture Extension strategies, further supports individuals in this sector.

Policy Level Actions on Crop Cultivation: The National Agriculture Policy of Bangladesh outlines the government's policies for crop production. The policy emphasizes crop diversification as a major component of crop production policy. The government has also adopted short, medium, and long-term action plans to meet the future needs of the growing population. This policy can help individuals involved in crop cultivation related CALOs like Maize Cultivation, Mung bean cultivation, Watermelon cultivation, Sunflower cultivation, Stress Tolerant Vegetables by promoting government's action plans to meet the future needs of the growing population, subsidies on agricultural inputs, availability of agricultural inputs, and facilitation of agricultural credit can help increase agricultural production. This can benefit individuals involved in crop cultivation by improving their productivity and income.

Policy Level Actions on Integrated Farming: While there isn't a specific policy on integrated farming, the government encourages practices that promote the sustainable use of resources. The government recognizes the potential of integrated rice-fish farming in increasing food production and contributing to food security. These policies can help individuals involved in integrated farming by promoting sustainable and productive farming practices for CALOs like Integrated Agriculture and Poultry, Integrated agriculture farming, Integrated vegetable cultivation.

These policies reflect the government's commitment to promoting sustainable and productive agricultural practices in Bangladesh. They aim to address the challenges of food security, poverty reduction, and sustainable development, while also considering the welfare of resource-poor people and the need for better nutrition

Table 9: Legal framework supporting CALO implementation

CALO	Broad Category	Policy
Sheep rearing	Livestock Rearing	National Livestock Development Policy
Pig rearing		
Duck rearing		
Native Poultry Rearing		
Native Chicken Rearing		
F-1 Calf Rearing		
Sheep and Duck rearing		
Crab fattening	Aquaculture	National Aquaculture Development Strategy and Action Plan of Bangladesh (2013–2020)
Carp fish polyculture		
Duck and Fish farming		
Saline water fisheries		
Brackishwater Fish Polyculture		
Maize Cultivation	Crop Cultivation	National Agriculture Policy of Bangladesh
Mung bean cultivation		
Watermelon cultivation		
Sunflower cultivation		
Stress Tolerant Vegetable		
Integrated Agriculture and Poultry	Integrated Farming	No specific policy, however, government recognizes the potential of integrated agricultural activities
Integrated agriculture farming		
Integrated vegetable cultivation		

The political and legal landscape for CALO implementation was also assessed from qualitative interviews. Questions regarding specific policy that may help CALO were asked to the representative government and project officials. The findings reflect a blend of support and challenges, as evidenced by statements from key informant interviews across various districts.

A consistent theme emerges that government policies and departmental support play a pivotal role in the implementation and success of CALOs. In districts like Rangamati and Khulna, government engagement appears proactive and supportive. The Fisheries Officer from Rangamati noted,

Government policies are in place for the implementation of CALO, and the government seems adequately willing. I hope these policies will work appropriately.

Similarly, the Agriculture Office in Dacope of Khulna district highlighted the active role of the land department consistently working towards the success of the CALO, and they respond well to their responsibilities. These statements suggest a favorable political environment in some regions, where government policies and departments facilitate the implementation of CALOs.

However, the situation is not uniformly positive. In Bagerhat, the District Coordinator pointed out a gap between directives and policy support:

For CALO implementation, there is no improvement in government policy...We have instructions to implement CALO, but we don't see anything in the government policy.

This sentiment is echoed in Barguna, where the lack of a formal government policy leads to reliance on ad hoc approaches:

In simple terms, we don't have any government policy. We work according to our policies.

These discrepancies indicate that while some areas benefit from structured support, others face a lack of integrated governmental policy, potentially hindering the marketability and broader adoption of CALOs.

Legal factors influencing the marketability of CALOs primarily revolve around regulatory challenges and the availability of government subsidies and funding, which are critical for enabling wider adoption and implementation. Subsidies and funding are one legal aspect that significantly impacts the marketability of CALOs. The Agriculture Officer in Rangamati Sadar mentions,

> *There is government funding available for CALO initiatives, where each group will receive approximately 30,000 taka as seed money.*

This kind of support is vital for kickstarting CALO activities and enhancing their marketability by lowering the initial barriers for communities. Contrastingly, the Agriculture Extension Office in Sandwip reveals a lack of financial support:

> *The residents of the area have not received any kind of government subsidy or incentive except for the implementation of a demonstration project under government management.*

The inconsistency in legal support for subsidies across different regions can lead to uneven market penetration and success of CALOs.

In summary, while political and legal frameworks in some regions actively support the adoption and expansion of CALOs, inconsistencies and gaps in these frameworks in other areas pose significant challenges. To enhance the marketability and overall success of CALOs, it is crucial for policies to be harmonized and for legal support mechanisms like subsidies and regulatory adaptations to be uniformly implemented. This alignment would not only aid in smooth implementation but also bolster the market confidence in CALOs, making them a more attractive option for communities adapting to climate variability.

3.3.3 Social and Environmental Aspects of CALO Marketability

The marketability of Climate Adaptive Livelihood Options (CALOs) can be significantly influenced by social and environmental factors. The social acceptability of CALOs hinges on community engagement and the direct benefits these options provide to local populations. For instance, initiatives that involve local communities in the management and decision-making processes are more likely to be embraced and sustained. This includes the development of livelihood options that are not only resilient to climate change but also enhance social equity and empowerment, particularly among vulnerable groups such as women, the disabled, and the economically disadvantaged. Additionally, education and training programs that increase local knowledge and skills related to CALOs can boost their adoption and effectiveness, leading to improved community resilience and socio-economic stability.

Environmentally, CALOs that contribute to the preservation and enhancement of natural resources are more marketable. This involves practices that promote biodiversity, improve soil and water quality, and reduce dependency on chemical inputs. For example, agroforestry, sustainable aquaculture, and organic farming not only adapt well to changing climate conditions but also help in carbon sequestration and the maintenance of ecosystem services. Moreover, CALOs that are designed to be sustainable and minimize environmental impact resonate more with consumers and policymakers focused on reducing ecological footprints and achieving sustainability targets.

The qualitative findings from various districts concerning the environmental aspects of Climate Adaptive Livelihood Options (CALOs) shed light on both the potential and challenges of integrating these practices into local ecosystems and economies. These insights, drawn from key informant interviews (KIIs) with local officials and experts, highlight the nuanced interplay between CALOs and environmental sustainability, significantly impacting their marketability.

In Rangamati Sadar, a KII with Fisheries Officer emphasized the broader ecological impacts, noting,

Through this project, it will be possible to protect the balance of natural resources,

highlighting the role of CALOs in maintaining ecological equilibrium. This perspective was echoed by an Agriculture Officer in Dacope who mentioned the strategic selection of CALOs to enhance resource access, thus bolstering their marketability by aligning with environmental management goals.

KII of Agriculture and Fisheries Officer in Chilmari reveal the delicate balance required in CALO implementation. The Agriculture Officer mentioned,

Our target is to work without causing harm to the environment...we are currently working with this philosophy in mind,

underscoring the commitment to sustainable practices. However, the Fisheries Officer from the same upazila highlighted a significant challenge:

Earlier we had a variety of aquatic animals in this area... But now they are on the verge of extinction due to excessive pesticide use.

This stresses the need for sustainable use of chemicals in CALOs, as overuse can lead to biodiversity loss, potentially tarnishing the marketability of these initiatives.

From Bagerhat, the District Coordinator provided a compelling vision of how CALOs could enhance local ecosystems:

Due to our livelihood activities, afforestation will take place in this region. The number of wild animals in the area will increase, and along with them, the number of birds will increase significantly.

Furthermore, the respondent also highlighted the dual benefits for climate change mitigation,

We are working on carbon elimination and oxygen production... also working on aspects that benefit climate change mitigation.

This positions CALOs not just as livelihood options but as integral components of local climate strategies. District Coordinator from Patuakhali touched on the community engagement aspect, stating,

Through this project we have tried to make every person understand how to deal with climate change.

This community-centric approach enhances the acceptability and effectiveness of CALOs, making them more marketable as community-driven solutions to environmental challenges.

Overall, these qualitative insights illustrate the potential of CALOs to be marketed not only as economically beneficial but also as environmentally sustainable and socially responsible options that align with global trends towards sustainability and conservation. By enhancing local ecosystems, reducing reliance on unsustainable practices, and aligning with broader environmental management and climate adaptation goals, CALOs not only offer sustainable livelihood options but also meet growing consumer and policy demand for environmentally responsible solutions. The insights from these districts reflect a robust foundation for the scaling and enhanced market adoption of CALOs,

provided that the integration of these options remains attentive to sustainable practices and community involvement.

The qualitative data gathered highlights the profound social impact of CALOs, revealing their potential to enhance marketability by contributing significantly to community development and social capital. In Rowangchhari, the emphasis on regular meetings among farmers facilitates a robust exchange of experiences and strategies. One livestock expert highlighted the value of these gatherings, stating,

"We conduct regular meetings where various farmers participate, allowing everyone to become familiar with each other's weaknesses, failures, and experiences. This has contributed to increasing awareness in parallel and enhancing social capital."

Such initiatives not only foster a sense of community but also enhance the collective ability to address challenges and share successful practices, thereby strengthening the overall resilience and productivity of the community.

The role of training as part of CALOs was emphasized by a representative from Hatiya, who said,

"We provide various types of training to contribute to the socio-economic development of society, which can contribute to education, health, and other aspects."

Training programs associated with CALOs not only equip individuals with the skills necessary for adapting to climate changes but also improve their employability and social mobility, thereby contributing to broader socio-economic development.

In Dacope, an agriculture officer shared insights into the economic success from CALOs and its positive repercussions on social infrastructure:

"Due to the economic success resulting from the implementation of the CALO project, there has been noticeable progress in the education and health sectors."

By generating additional resources, CALOs help alleviate financial constraints, enabling better funding and improvements in critical social sectors.

Finally, the linkage between economic and social benefits is a recurring theme in the findings. In Bandarban Sadar, a fisheries officer articulated this connection:

"Economic development is intricately linked with fulfilling the fundamental needs of people. CALO is proving to be economically viable overall. It is hoped that in the long run, it will play a significant role in human resource development and social network building."

This statement captures the broader societal impacts of CALOs, suggesting that economic gains from such initiatives lead to enhanced human capital development.

Thus, by enhancing social capital, directly improving health and education services, and providing economic upliftment that feeds into broader human resource development, CALOs present a compelling proposition for marketability. These initiatives do more than transform livelihoods; they catalyze community-wide advancements, making them attractive to stakeholders ranging from local governments to international development organizations.

Therefore, the findings surrounding the environmental and social aspects of CALOs underscore their significant potential for marketability by addressing critical areas of sustainable development. Environmentally, CALOs leverage local natural resources effectively, contribute to biodiversity preservation, and enhance ecosystem resilience, crucial for areas facing water scarcity and

biodiversity loss. Socially, these initiatives are pivotal in strengthening community bonds through regular meetings and shared experiences, directly improving education and health services, and increasing socio-economic development through targeted training programs. Together, these aspects demonstrate that CALOs not only offer a pathway to environmentally sustainable practices but also foster robust social infrastructure, enhancing their appeal and adoption across communities affected by climate variability and change.

In conclusion, the comprehensive analysis of CALOs across financial, technological, political, legal, social, and environmental aspects reveals their significant potential and challenges in marketability. Financially and technologically, while most CALOs exhibit good market potential, areas like Carp fish polyculture and Sunflower cultivation require enhancements to improve their viability and adoption. Politically and legally, the need for consistent supportive frameworks is crucial; harmonized policies and legal support mechanisms such as subsidies and regulatory adaptations could greatly enhance CALOs' effectiveness and attractiveness. Socially and environmentally, CALOs demonstrate a strong ability to foster community engagement, enhance local ecosystems, and contribute positively to sustainable development, which are key drivers for their adoption. Overall, when these aspects are aligned and effectively managed, CALOs not only present a sustainable option for addressing climate change impacts but also offer substantial opportunities for marketability and economic growth, underscoring their broad potential in transforming livelihoods in a changing climate.

3.4 Gender impact analysis of CALOs

This section of the report analyzes the gender impact of Climate Adaptive Livelihood Options (CALOs) across different agro-ecological zones. The study explores the socio-economic and environmental advancements facilitated by CALOs for women, examining changes in income, access to financial resources, educational opportunities, leadership roles, and participation in economic activities. The objective is to understand how these initiatives have transformed the lives of women in diverse settings.

The study assessed income changes among participants of various Climate Adaptive Livelihood Options (CALOs). It highlights those activities like Mung bean cultivation and Saline water fisheries universally reported slight income increases. Crab fattening and Bamboo-based Handicrafts observed the most substantial positive impacts, with 41.7% and 37.5% of participants respectively experiencing significant income increases. Conversely, Sunflower cultivation and Integrated Agriculture and Poultry show the highest stability, with 58.3% and 11% of participants reporting unchanged income levels.

Table 10: Changes in women's income since the implementation of CALOs (Response in %, N=1011)

CALO Name	Increased significantly	Increased slightly	Remained the same	Decreased slightly	Decreased significantly
Crab fattening	41.7	58.3	0.0	0.0	0.0
Carp fish polyculture	2.0	46.9	51.0	0.0	0.0
Sheep rearing	31.9	65.3	2.8	0.0	0.0
Pig rearing	16.7	79.2	0.0	4.2	0.0
Integrated Agriculture and Poultry	0.0	84.9	11.0	4.1	0.0
Duck and Fish farming	22.2	58.7	15.9	3.2	0.0
Integrated agriculture farming	9.3	88.7	0.0	1.0	1.0
Green Job (Bamboo-based Handicraft)	37.5	62.5	0.0	0.0	0.0
Duck rearing	18.8	75.0	6.3	0.0	0.0
Maize Cultivation	8.3	83.3	8.3	0.0	0.0
Integrated vegetable cultivation	11.1	82.5	3.2	1.6	1.6
Mung bean cultivation	0.0	100.0	0.0	0.0	0.0
Watermelon cultivation	4.2	83.3	12.5	0.0	0.0
Vermicompost	6.9	69.0	24.1	0.0	0.0
Saline water fisheries	0.0	100.0	0.0	0.0	0.0
Sheep and Duck rearing	2.0	95.9	2.0	0.0	0.0
Brackishwater Fish Polyculture	27.1	68.8	4.2	0.0	0.0
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	11.3	83.1	1.4	2.8	1.4
Sunflower cultivation	0.0	41.7	58.3	0.0	0.0
Native Poultry Rearing	0.0	95.8	4.2	0.0	0.0
Native Chicken Rearing	7.5	74.2	10.8	7.5	0.0
F-1 Calf Rearing	0.0	66.7	29.2	4.2	0.0
Total	11.8	76.3	9.9	1.8	0.3

The study tried to assess how women's access to financial resources has changed after participating in various CALOs, with percentages indicating the level of improvement. Notably, activities such as Crab fattening and Bamboo-based Handicraft show substantial improvements, with 50% and 100% of participants respectively reporting a great increase. On the other hand, Sunflower cultivation displayed the most stability with 45.8% reporting no change. Overall, a significant majority, 81.4%, experienced some improvement, underscoring the positive impact of CALOs on enhancing women's financial access across diverse agricultural activities.

Table 11: Changes in women's access to financial resources post-engagement in CALOs (Response in %, N=1011)

CALO Name	Greatly improved	Somewhat improved	No change	Somewhat worsened
Crab fattening	50.0	50.0	0.0	0.0
Carp fish poly culture	6.1	69.4	24.5	0.0
Sheep rearing	31.9	68.1	0.0	0.0
Pig rearing	25.0	75.0	0.0	0.0
Integrated Agriculture and Poultry	0.0	84.9	9.6	5.5
Duck and Fish farming	22.2	57.1	17.5	3.2
Integrated agriculture farming	9.3	88.7	0.0	0.0
Green Job (Bamboo-based Handicraft)	0.0	100.0	0.0	0.0
Duck rearing	14.6	85.4	0.0	0.0
Maize Cultivation	2.1	87.5	10.4	0.0
Integrated vegetable cultivation	9.5	85.7	3.2	0.0
Mung bean cultivation	25.0	75.0	0.0	0.0
Watermelon cultivation	4.2	91.7	4.2	0.0
Vermicompost	3.4	79.3	17.2	0.0
Saline water fisheries	0.0	100.0	0.0	0.0
Sheep and Duck rearing	0.0	98.0	2.0	0.0
Brackishwater Fish Polyculture	2.1	97.9	0.0	0.0
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	8.5	90.1	0.0	1.4
Sunflower cultivation	0.0	54.2	45.8	0.0
Native Poultry Rearing	4.2	95.8	0.0	0.0
Native Chicken Rearing	7.5	78.5	7.5	6.5
F-1 Calf Rearing	0.0	75.0	25.0	0.0
Total	10.3	81.4	6.7	1.3

The study assessed the evolution of women's participation in economic activities post-engagement in various CALOs, quantified by significant and slight increases, stability, and rare decreases in income. Notable observations include Mung bean cultivation, where a total of 100% of participants reported increased income—41.7% significantly and 58.3% slightly. Crab fattening also shows a high impact with 37.5% experiencing significant increases. Conversely, activities like Integrated Agriculture and Poultry indicate more stability, with 12.3% of participants reporting no change. This data underscores the differential impact of CALOs on women's economic participation across diverse agricultural practices.

Table 12: Women's participation in economic activities post-engagement in CALOs (Response in %, N=1011)

CALO Name	Increased significantly	Increased slightly	Remained the same	Decreased slightly	Decreased significantly
Crab fattening	37.5	62.5	0.0	0.0	0.0
Carp fish polyculture	4.1	85.7	10.2	0.0	0.0
Sheep rearing	23.6	72.2	4.2	0.0	0.0
Pig rearing	25.0	75.0	0.0	0.0	0.0
Integrated Agriculture and Poultry	5.5	78.1	12.3	4.1	0.0
Duck and Fish farming	20.6	60.3	17.5	1.6	0.0
Integrated agriculture farming	4.1	93.8	0.0	0.0	2.1
Green Job (Bamboo-based Handicraft)	25.0	75.0	0.0	0.0	0.0
Duck rearing	22.9	77.1	0.0	0.0	0.0
Maize Cultivation	4.2	85.4	10.4	0.0	0.0
Integrated vegetable cultivation	9.5	88.9	0.0	0.0	1.6
Mung bean cultivation	41.7	58.3	0.0	0.0	0.0
Watermelon cultivation	12.5	87.5	0.0	0.0	0.0
Vermicompost	20.7	62.1	17.2	0.0	0.0
Saline water fisheries	0.0	100.0	0.0	0.0	0.0
Sheep and Duck rearing	0.0	95.9	4.1	0.0	0.0
Brackishwater Fish Polyculture	22.9	77.1	0.0	0.0	0.0
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	9.9	88.7	0.0	1.4	0.0
Sunflower cultivation	8.3	83.3	4.2	4.2	0.0
Native Poultry Rearing	4.2	95.8	0.0	0.0	0.0
Native Chicken Rearing	10.8	82.8	3.2	3.2	0.0
F-1 Calf Rearing	4.2	70.8	25.0	0.0	0.0
Total	12.8	81.1	4.9	0.9	0.3

The study found the trends in women's leadership roles in economic initiatives post-engagement in CALOs, highlighting the percentage of respondents reporting changes in leadership participation. Notably, crab fattening and Mung bean cultivation show the most substantial increases in leadership roles with 45.8% and 50% of participants respectively reporting "Many more" taking on such roles. On the other hand, Green Job (Bamboo-based Handicraft) and Saline water fisheries each had 100% of participants observing "A few more" women taking on leadership roles.

Table 13: Trends in Women's Leadership Roles in Economic Initiatives Post-Engagement in CALO (Response in %, N=1011)

CALO Name	Many more	A few more	About the same	Fewer	None at all
Crab fattening	45.8	54.2	0.0	0.0	0.0
Carp fish polyculture	2.0	95.9	2.0	0.0	0.0
Sheep rearing	15.3	69.4	15.3	0.0	0.0
Pig rearing	29.2	70.8	0.0	0.0	0.0
Integrated Agriculture and Poultry	0.0	61.6	37.0	1.4	0.0
Duck and Fish farming	19.0	57.1	22.2	1.6	0.0
Integrated agriculture farming	3.1	90.7	6.2	0.0	0.0
Green Job (Bamboo-based Handicraft)	0.0	100.0	0.0	0.0	0.0
Duck rearing	6.3	89.6	4.2	0.0	0.0
Maize Cultivation	0.0	85.4	14.6	0.0	0.0
Integrated vegetable cultivation	4.8	93.7	1.6	0.0	0.0
Mung bean cultivation	50.0	50.0	0.0	0.0	0.0
Watermelon cultivation	20.8	75.0	0.0	4.2	0.0
Vermicompost	17.2	62.1	20.7	0.0	0.0
Saline water fisheries	0.0	100.0	0.0	0.0	0.0
Sheep and Duck rearing	2.0	95.9	2.0	0.0	0.0
Brackishwater Fish Polyculture	0.0	89.6	10.4	0.0	0.0
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	0.0	97.2	1.4	0.0	1.4
Sunflower cultivation	4.2	79.2	16.7	0.0	0.0
Native Poultry Rearing	0.0	91.7	8.3	0.0	0.0
Native Chicken Rearing	5.4	88.2	3.2	3.2	0.0
F-1 Calf Rearing	0.0	87.5	12.5	0.0	0.0
Total	7.9	82.1	9.3	0.6	0.1

The insights from discussion with beneficiaries about the impact of CALOs reveal significant strides in women's leadership and economic empowerment across various communities. Beneficiaries exemplify this transformation. A beneficiary share,

After joining the CALO program, I was able to start my own small business. This not only boosted my confidence but also positioned me as a leader in our community. People now come to me for advice, and I help organize local market activities.

This narrative highlights the dual impact of CALOs in enhancing economic independence and elevating women's roles within their communities.

Another beneficiary reflects on the economic benefits:

The training and support I received have allowed me to earn a steady income through diversified activities... I manage finances that support my family's needs and even plan for future investments.

These stories illustrate how CALOs empower women to become key economic players and respected leaders, fostering a shift in traditional gender roles and contributing to the resilience and development of their communities. Through these initiatives, women are not just participating; they are leading and reshaping societal norms, proving the profound societal impact of empowering women economically and in leadership roles.

The study also tried to outline the changes in educational opportunities for women post-engagement in various Climate Adaptive Livelihood Options (CALOs), with responses measured in percentages. For instance, 45.8% of participants in Crab fattening reported significant improvements in educational opportunities, and 54.2% noted slight improvements. Similarly, Green Job (Bamboo-based Handicraft) participants also experienced substantial improvements, with 37.5% reporting significant and 62.5% slight improvements. Conversely, Watermelon cultivation and Vermicompost show a more stable scenario with 50% and 72.4% of participants respectively reporting no change in educational opportunities.

Table 14: Changes in educational opportunities for women post-engagement in CALOs (Response in %, N=1011)

CALO Name	Improved significantly	Improved slightly	No change	Worsened slightly	Worsened significantly
Crab fattening	45.8	54.2	0.0	0.0	0.0
Carp fish polyculture	16.3	51.0	32.7	0.0	0.0
Sheep rearing	19.4	76.4	4.2	0.0	0.0
Pig rearing	33.3	66.7	0.0	0.0	0.0
Integrated Agriculture and Poultry	20.5	74.0	4.1	1.4	0.0
Duck and Fish farming	20.6	73.0	6.3	0.0	0.0
Integrated agriculture farming	14.4	85.6	0.0	0.0	0.0
Green Job (Bamboo-based Handicraft)	37.5	62.5	0.0	0.0	0.0
Duck rearing	4.2	62.5	33.3	0.0	0.0
Maize Cultivation	2.1	91.7	6.3	0.0	0.0
Integrated vegetable cultivation	7.9	74.6	17.5	0.0	0.0
Mung bean cultivation	0.0	50.0	50.0	0.0	0.0
Watermelon cultivation	8.3	37.5	50.0	0.0	4.2
Vermicompost	3.4	24.1	72.4	0.0	0.0
Saline water fisheries	0.0	100.0	0.0	0.0	0.0
Sheep and Duck rearing	18.4	75.5	6.1	0.0	0.0
Brackishwater Fish Polyculture	6.3	93.8	0.0	0.0	0.0
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber.)	15.5	84.5	0.0	0.0	0.0
Sunflower cultivation	0.0	45.8	54.2	0.0	0.0
Native Poultry Rearing	0.0	100.0	0.0	0.0	0.0
Native Chicken Rearing	4.3	95.7	0.0	0.0	0.0
F-1 Calf Rearing	0.0	87.5	12.5	0.0	0.0
Total	12.6	75.4	11.9	0.1	0.1

Across all Agro Ecological Zones, the Active Tista Floodplain shows the highest percentage of respondents noting slight improvements in educational opportunities for women at 92.7%. The Young Meghna Estuarine Floodplain follows with 86.9%, the Sylhet Basin at 83.8%, and the Ganges Tidal Floodplain at 62.8%. Each zone demonstrates positive trends, indicating significant enhancements in women's educational opportunities, with the Active Tista leading markedly.

Table 15: Changes in Educational Opportunities for Women by Agro Ecological Zone (Response in %, N=1011)

Agro-ecological areas	Improved significantly	Improved slightly	No change	Worsened slightly	Worsened significantly
Ganges Tidal Floodplain	18.2	62.8	18.8	0.0	0.2
Young Meghna Estuarine Floodplain	10.1	86.9	2.5	0.5	0.0
Active Tista Flood plain	1.2	92.7	6.1	0.0	0.0
Sylhet Basin	9.2	83.8	7.0	0.0	0.0
Total	12.6	75.4	11.9	0.1	0.1

The study tried to find out the extent to which women have enhanced their ability to adapt to environmental changes after participating in CALOs. Notably, Pig rearing shows a significant 41.7% of participants reporting greatly increased adaptation capacity, with 58.3% noting some improvement. Crab fattening also stands out, with half of the participants experiencing a great increase in adaptation capacity. The table indicates strong positive shifts, with most activities showing significant or some improvement in women's adaptation capacities.

Table 16: Changes in women's adaptation capacity post-engagement in CALOs (Response in %, N=1011)

CALO Name	Greatly increased	Somewhat increased	No change	Somewhat decreased
Crab fattening	50	50	0	0
Carp fish polyculture	0	83.7	16.3	0
Sheep rearing	27.8	69.4	2.8	0
Pig rearing	41.7	58.3	0	0
Integrated Agriculture and Poultry	0	82.2	16.4	1.4
Duck and Fish farming	17.5	63.5	17.5	1.6
Integrated agriculture farming	10.3	88.7	1	0
Green Job (Bamboo-based Handicraft)	0	100	0	0
Duck rearing	4.2	93.8	2.1	0
Maize Cultivation	0	91.7	8.3	0
Integrated vegetable cultivation	6.3	88.9	4.8	0
Mung bean cultivation	20.8	79.2	0	0
Watermelon cultivation	12.5	83.3	4.2	0
Vermicompost	13.8	37.9	48.3	0
Saline water fisheries	0	100	0	0
Sheep and Duck rearing	0	98	2	0
Brackishwater Fish Polyculture	2.1	97.9	0	0
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	4.2	95.8	0	0
Sunflower cultivation	0	54.2	45.8	0
Native Poultry Rearing	0	100	0	0
Native Chicken Rearing	10.8	84.9	4.3	0
F-1 Calf Rearing	0	87.5	12.5	0
Total	9.4	82.9	7.5	0.2

The study found an increase in social connectivity among participants, with notable enhancements across various CALO activities. For instance, crab fattening and Mung bean cultivation both report significant increases in social involvement, with 45.8% of participants each noting a substantial rise. Green Job (Bamboo-based Handicraft) stands out with all participants (100%) experiencing an increase in their social networks.

Table 17: Changes in women's involvement in social networks and support systems post-engagement in CALOs (Response in %, N=1011)

CALO Name	Significantly increased	Increased	No change	Decreased
Crab fattening	45.8	54.2	0.0	0.0
Carp fish polyculture	0.0	95.9	4.1	0.0
Sheep rearing	29.2	62.5	8.3	0.0
Pig rearing	29.2	66.7	4.2	0.0
Integrated Agriculture and Poultry	0.0	63.0	30.1	6.8
Duck and Fish farming	20.6	58.7	19.0	1.6
Integrated agriculture farming	7.2	90.7	2.1	0.0
Green Job (Bamboo-based Handicraft)	0.0	100.0	0.0	0.0
Duck rearing	8.3	91.7	0.0	0.0
Maize Cultivation	0.0	91.7	8.3	0.0
Integrated vegetable cultivation	6.3	88.9	4.8	0.0
Mung bean cultivation	45.8	54.2	0.0	0.0
Watermelon cultivation	16.7	83.3	0.0	0.0
Vermicompost	3.4	82.8	13.8	0.0
Saline water fisheries	0.0	100.0	0.0	0.0
Sheep and Duck rearing	0.0	93.9	6.1	0.0
Brackishwater Fish Polyculture	4.2	93.8	2.1	0.0
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	1.4	97.2	1.4	0.0
Sunflower cultivation	4.2	91.7	4.2	0.0
Native Poultry Rearing	4.2	95.8	0.0	0.0
Native Chicken Rearing	8.6	84.9	5.4	1.1
F-1 Calf Rearing	0.0	91.7	8.3	0.0
Total	9.5	83.0	6.8	0.7

The study found a significant increase in community trust towards women after their participation in CALOs. For example, 50% of participants in Crab fattening and 33.3% in Pig rearing reported great increases in trust. Activities such as Green Job (Bamboo-based Handicraft) and Maize Cultivation saw all participants noting improved trust. Overall, the majority of responses across various CALOs indicated either a great or some increase in trust, demonstrating the positive community perception of women's involvement in these initiatives.

Table 18: Changes in community trust in women post-engagement in CALOs (Response in %, N=1011)

CALO Name	Greatly increased	Somewhat increased	No change	Somewhat decreased
Crab fattening	50.0	50.0	0.0	0.0
Carp fish polyculture	6.1	91.8	2.0	0.0
Sheep rearing	27.8	70.8	1.4	0.0
Pig rearing	33.3	66.7	0.0	0.0
Integrated Agriculture and Poultry	0.0	83.6	13.7	2.7
Duck and Fish farming	17.5	60.3	19.0	3.2
Integrated agriculture farming	12.4	86.6	1.0	0.0
Green Job (Bamboo-based Handicraft)	0.0	100.0	0.0	0.0
Duck rearing	10.4	89.6	0.0	0.0
Maize Cultivation	0.0	100.0	0.0	0.0
Integrated vegetable cultivation	9.5	90.5	0.0	0.0
Mung bean cultivation	16.7	83.3	0.0	0.0
Watermelon cultivation	29.2	70.8	0.0	0.0
Vermicompost	6.9	75.9	17.2	0.0
Saline water fisheries	0.0	100.0	0.0	0.0
Sheep and Duck rearing	0.0	98.0	2.0	0.0
Brackishwater Fish Polyculture	0.0	100.0	0.0	0.0
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	0.0	100.0	0.0	0.0
Sunflower cultivation	8.3	91.7	0.0	0.0
Native Poultry Rearing	0.0	100.0	0.0	0.0

In assessing community trust in women post-CALO engagement across Agro-Ecological Zones, the Active Tista Floodplain exhibits the highest level of trust with 92.1% of respondents noting it has somewhat increased. This is followed by the Ganges Tidal Floodplain at 86.3%, the Sylhet Basin at 81.0%, and the Young Meghna Estuarine Floodplain at 81.4%. Each zone shows strong positive shifts, with the Active Tista Floodplain leading significantly in enhanced community trust.

Table 19: Changes in community trust in women post-engagement by Agro Ecological Zone (Response in %, N=1011)

Agro-ecological areas	Greatly increased	Somewhat increased	No change	Somewhat decreased
Ganges Tidal Floodplain	13.1	86.3	0.6	0.0
Young Meghna Estuarine Floodplain	1.0	81.4	15.1	2.5
Active Tista Flood plain	3.0	92.1	4.8	0.0
Sylhet Basin	18.3	81.0	0.7	0.0
Total	9.8	85.6	4.2	0.5

The study tried to assess the changes in women's participation in community decision-making following their involvement in CALOs. Highlights include Crab Fattening, where 100% of respondents reported an increase, with 50% noting a significant rise. For CALOs like Pig Rearing and Watermelon Cultivation, 12.5% and 25% of participants, respectively, reported greatly increased participation. Across various CALOs, substantial increases are evident, with over 84.4% of respondents across all activities reporting enhanced involvement in decision-making, underscoring significant strides towards gender inclusivity in community leadership roles.

Table 20: Changes in women's participation in community decision-making post-engagement in CALOs (Response in %, N=1011)

CALO Name	Greatly increased	Somewhat increased	No change	Somewhat decreased
Crab fattening	50.0	50.0	0.0	0.0
Carp fish polyculture	8.2	87.8	4.1	0.0
Sheep rearing	19.4	75.0	5.6	0.0
Pig rearing	12.5	87.5	0.0	0.0
Integrated Agriculture and Poultry	0.0	83.6	15.1	1.4
Duck and Fish farming	17.5	65.1	15.9	1.6
Integrated agriculture farming	11.3	86.6	2.1	0.0
Green Job (Bamboo-based Handicraft)	12.5	87.5	0.0	0.0
Duck rearing	10.4	89.6	0.0	0.0
Maize Cultivation	0.0	91.7	8.3	0.0
Integrated vegetable cultivation	9.5	88.9	1.6	0.0
Mung bean cultivation	25.0	75.0	0.0	0.0
Watermelon cultivation	25.0	75.0	0.0	0.0
Vermicompost	13.8	69.0	17.2	0.0
Saline water fisheries	0.0	100.0	0.0	0.0
Sheep and Duck rearing	0.0	98.0	2.0	0.0
Brackishwater Fish Polyculture	0.0	93.8	6.3	0.0
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber.)	4.2	91.5	4.2	0.0
Sunflower cultivation	8.3	70.8	20.8	0.0
Native Poultry Rearing	0.0	100.0	0.0	0.0
Native Chicken Rearing	5.4	86.0	7.5	1.1
F-1 Calf Rearing	0.0	87.5	12.5	0.0
Total	9.3	84.4	6.0	0.3

The data quantifies the levels of participation by marginalized groups in various Climate Adaptive Livelihood Options (CALOs), highlighting the degree of engagement. For instance, Duck rearing shows significant engagement with 66.7% of participants highly involved and an additional 4.2% fully involved. In contrast, Watermelon cultivation has all participants only slightly involved. Mung bean cultivation and Vermicompost also exhibit strong engagement, with 91.7% and 75.9% of participants respectively highly involved, indicating varying levels of inclusivity across different CALOs.

Table 21: Active involvement of marginalized groups in CALO activities (Response in %, N=1011)

CALO Name	Not involved at all	Slightly involved	Moderately involved	Highly involved	Fully involved
Crab fattening	0.0	8.3	91.7	0.0	0.0
Carp fish polyculture	0.0	18.4	59.2	16.3	6.1
Sheep rearing	0.0	18.1	52.8	27.8	1.4
Pig rearing	0.0	37.5	62.5	0.0	0.0
Integrated Agriculture and Poultry	0.0	53.4	46.6	0.0	0.0
Duck and Fish farming	0.0	39.7	47.6	11.1	1.6
Integrated agriculture farming	0.0	38.1	24.7	34.0	3.1
Green Job (Bamboo-based Handicraft)	0.0	62.5	37.5	0.0	0.0
Duck rearing	0.0	6.3	22.9	66.7	4.2
Maize Cultivation	0.0	52.1	43.8	4.2	0.0
Integrated vegetable cultivation	34.9	22.2	25.4	12.7	4.8
Mung bean cultivation	0.0	0.0	8.3	91.7	0.0
Watermelon cultivation	0.0	100.0	0.0	0.0	0.0
Vermicompost	0.0	6.9	17.2	75.9	0.0
Saline water fisheries	20.8	37.5	41.7	0.0	0.0
Sheep and Duck rearing	0.0	40.8	44.9	14.3	0.0
Brackishwater Fish Polyculture	0.0	64.6	27.1	8.3	0.0
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	0.0	69.0	16.9	11.3	2.8
Sunflower cultivation	0.0	4.2	16.7	58.3	20.8
Native Poultry Rearing	12.5	79.2	8.3	0.0	0.0
Native Chicken Rearing	0.0	65.6	7.5	25.8	1.1
F-1 Calf Rearing	0.0	16.7	75.0	8.3	0.0
Total	3.0	40.2	33.7	21.1	2.1

The Sylhet Basin shows the highest percentage of moderately involved marginalized groups at 46.5%, closely followed by the Active Tista Floodplain at 38.2%. The Young Meghna Estuarine Floodplain and Ganges Tidal Floodplain report 39.2% and 26.5%, respectively, indicating a notable level of engagement across these zones, with the Sylhet Basin leading in moderate involvement.

Table 22: Active involvement of marginalized groups by Agro Ecological Zone (Response in %, N=1011)

Agro-ecological areas	Not involved at all	Slightly involved	Moderately involved	Highly involved	Fully involved
Ganges Tidal Floodplain	5.7	47.3	26.5	18.6	1.8
Young Meghna Estuarine Floodplain	0.0	53.3	39.2	7.0	0.5
Active Tista Flood plain	0.6	31.5	38.2	25.5	4.2
Sylhet Basin	0.0	6.3	46.5	44.4	2.8
Total	3.0	40.2	33.7	21.1	2.1

The study also tried to assess how women's employment opportunities have evolved across various CALOs. For instance, in Pig rearing and Green Job (Bamboo-based Handicraft), 100% of participants agree or strongly agree that their employment opportunities have increased. Crab fattening also shows a positive outcome with 100% agreement among respondents. On the other hand, Vermicompost presents a mixed response with 51.7% agreeing or strongly agreeing, alongside a notable 34.5% expressing disagreement or neutrality. This reflects varying degrees of impact on women's employment opportunities across different CALOs.

Table 23: Increased employment opportunities for women through CALO activities (Response in %, N=1011)

CALO Name	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Crab fattening	0.0	0.0	0.0	75.0	25.0
Carp fish polyculture	0.0	24.5	14.3	61.2	0.0
Sheep rearing	2.8	1.4	15.3	72.2	8.3
Pig rearing	0.0	0.0	0.0	91.7	8.3
Integrated Agriculture and Poultry	15.1	2.7	0.0	82.2	0.0
Duck and Fish farming	22.2	3.2	0.0	58.7	15.9
Integrated agriculture farming	1.0	4.1	6.2	85.6	3.1
Green Job (Bamboo-based Handicraft)	0.0	0.0	0.0	100.0	0.0
Duck rearing	6.3	4.2	20.8	58.3	10.4
Maize Cultivation	0.0	0.0	0.0	100.0	0.0
Integrated vegetable cultivation	0.0	0.0	7.9	85.7	6.3
Mung bean cultivation	20.8	4.2	25.0	50.0	0.0
Watermelon cultivation	0.0	0.0	4.2	83.3	12.5

Vermicompost	13.8	20.7	13.8	37.9	13.8
Saline water fisheries	0.0	0.0	0.0	100.0	0.0
Sheep and Duck rearing	0.0	4.1	12.2	83.7	0.0
Brackishwater Fish Polyculture	0.0	0.0	10.4	81.3	8.3
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber.)	0.0	0.0	0.0	94.4	5.6
Sunflower cultivation	8.3	41.7	4.2	41.7	4.2
Native Poultry Rearing	0.0	0.0	0.0	95.8	4.2
Native Chicken Rearing	12.9	1.1	4.3	80.6	1.1
F-1 Calf Rearing	0.0	0.0	4.2	95.8	0.0
Total	5.3	4.3	6.6	78.4	5.3

In the context of increased employment opportunities for women through CALO activities, the Active Tista Floodplain shows the highest level of agreement at 90.3%, indicating a substantial positive impact. The Ganges Tidal Floodplain follows with 79.2% agreement, while the Sylhet Basin and Young Meghna Estuarine Floodplain report lower but still significant agreement levels at 69.0% and 73.4%, respectively, highlighting widespread but varied improvements across zones.

Table 24: Increased employment opportunities for women through CALO activities by Agro Ecological Zone (Response in %, N=1011)

Agro-ecological areas	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Ganges Tidal Floodplain	3.0	6.1	4.2	79.2	7.5
Young Meghna Estuarine Floodplain	18.6	1.5	5.0	73.4	1.5
Active Tista Flood plain	0.0	0.0	3.0	90.3	6.7
Sylhet Basin	1.4	6.3	21.8	69.0	1.4
Total	5.3	4.3	6.6	78.4	5.3

The data presents responses on how evenly household chores are shared between men and women post-CALO engagement. For instance, in Green Job (Bamboo-based Handicraft) and Native Poultry Rearing, 100% of participants agree that chore distribution has become more equitable. Crab fattening and Pig rearing also show high agreement, with 95.8% and 91.7% respectively agreeing to a more balanced sharing of tasks. Conversely, Watermelon cultivation shows a more divided response, with 45.8% neutral and an equal percentage agreeing to increased sharing, indicating varied impacts across different CALOs.

Table 25: *Changes in household chore distribution between men and women post-engagement in CALOs (Response in %, N=1011)*

CALO Name	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Crab fattening	0.0	0.0	4.2	95.8	0.0
Carp fish polyculture	0.0	0.0	55.1	44.9	0.0
Sheep rearing	0.0	9.7	20.8	69.4	0.0
Pig rearing	0.0	4.2	4.2	91.7	0.0
Integrated Agriculture and Poultry	0.0	2.7	27.4	69.9	0.0
Duck and Fish farming	1.6	4.8	23.8	69.8	0.0
Integrated agriculture farming	1.0	6.2	22.7	70.1	0.0
Green Job (Bamboo-based Handicraft)	0.0	0.0	0.0	100.0	0.0
Duck rearing	2.1	2.1	39.6	56.3	0.0
Maize Cultivation	0.0	6.3	4.2	89.6	0.0
Integrated vegetable cultivation	0.0	3.2	19.0	74.6	3.2
Mung bean cultivation	0.0	0.0	12.5	87.5	0.0
Watermelon cultivation	0.0	4.2	45.8	45.8	4.2
Vermicompost	0.0	10.3	55.2	34.5	0.0
Saline water fisheries	0.0	0.0	37.5	62.5	0.0
Sheep and Duck rearing	0.0	0.0	24.5	75.5	0.0
Brackishwater Fish Polyculture	0.0	0.0	4.2	95.8	0.0
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	0.0	0.0	16.9	83.1	0.0
Sunflower cultivation	0.0	20.8	45.8	33.3	0.0
Native Poultry Rearing	0.0	0.0	0.0	100.0	0.0
Native Chicken Rearing	1.1	11.8	21.5	65.6	0.0
F-1 Calf Rearing	0.0	4.2	0.0	95.8	0.0
Total	0.4	4.5	22.7	72.0	0.3

The data indicates a positive shift in community respect for women's opinions following their engagement in CALO activities. For example, in Pig Rearing and Green Job (Bamboo-based Handicraft), 100% of participants agreed that respect for women's opinions has increased. Crab fattening also saw a high agreement at 95.8%. The majority of CALOs show that either all or the vast majority of respondents observed an increase in respect, with minimal or no respondents experiencing a decrease or neutrality towards women's opinions.

Table 26: Changes in Community Respect for Women's Opinions Post-CALO Integration (Response in %, N=1011)

CALO Name	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Crab fattening	0.0	0.0	0.0	95.8	4.2
Carp fish polyculture	0.0	4.1	38.8	57.1	0.0
Sheep rearing	1.4	1.4	4.2	88.9	4.2
Pig rearing	0.0	0.0	0.0	100.0	0.0
Integrated Agriculture and Poultry	0.0	9.6	8.2	82.2	0.0
Duck and Fish farming	0.0	0.0	4.8	92.1	3.2
Integrated agriculture farming	0.0	2.1	2.1	95.9	0.0
Green Job (Bamboo-based Handicraft)	0.0	0.0	0.0	100.0	0.0
Duck rearing	0.0	0.0	8.3	91.7	0.0
Maize Cultivation	0.0	0.0	2.1	97.9	0.0
Integrated vegetable cultivation	0.0	0.0	1.6	90.5	7.9
Mung bean cultivation	0.0	0.0	4.2	95.8	0.0
Watermelon cultivation	0.0	0.0	0.0	95.8	4.2
Vermicompost	0.0	3.4	10.3	86.2	0.0
Saline water fisheries	0.0	0.0	0.0	100.0	0.0
Sheep and Duck rearing	0.0	0.0	8.2	91.8	0.0
Brackishwater Fish Polyculture	0.0	0.0	2.1	97.9	0.0
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	0.0	1.4	0.0	98.6	0.0
Sunflower cultivation	0.0	20.8	25.0	54.2	0.0
Native Poultry Rearing	0.0	0.0	0.0	100.0	0.0
Native Chicken Rearing	0.0	8.6	3.2	88.2	0.0
F-1 Calf Rearing	0.0	0.0	4.2	95.8	0.0
Total	0.1	2.7	5.7	90.3	1.2

The qualitative feedback from participants in CALOs highlights significant strides in social recognition and gender equality. One beneficiary vividly illustrates this change, stating,

> The CALO project have taught us that women can do just as well as men in any field, including leadership.

This statement captures the profound shift in societal attitudes towards gender equality, facilitated by the inclusive policies and practices of CALOs. Another community member shared,

> Women are now seen as important contributors to our community's resilience against climate impacts. Their involvement in CALOs has not only improved their own lives but has also brought about a cultural shift in how they are perceived and valued.

These statements underscore the broader cultural transformation within communities engaged in CALOs, where women are increasingly respected and valued as equal partners in all aspects of community and economic life. The programs have not only empowered women but also played a crucial role in changing societal norms, enhancing both social recognition and gender equality.

The below data highlights an overall positive shift in men's contributions to household tasks across various CALOs. Notably, in CALOs like Crab Fattening and Green Job (Bamboo-based Handicraft), 100% of participants agreed that men's involvement has increased. Similarly, other CALOs such as Maize Cultivation and Native Poultry Rearing show very high agreement levels at 93.8% and 95.8%, respectively. On the lower end, Sunflower cultivation shows the least increase with only 20.8% agreement. Overall, a significant majority, 75.1% of participants, observed increased participation by men in household duties post-CALO integration.

Table 27: *Increase in men's contribution to household tasks post-CALO integration (Response in %, N=1011)*

CALO Name	Disagree	Neutral	Agree	Strongly agree
Crab fattening	0.0	0.0	100.0	0.0
Carp fish polyculture	4.1	46.9	49.0	0.0
Sheep rearing	1.4	26.4	72.2	0.0
Pig rearing	12.5	8.3	79.2	0.0
Integrated Agriculture and Poultry	2.7	41.1	56.2	0.0
Duck and Fish farming	1.6	22.2	71.4	4.8
Integrated agriculture farming	2.1	24.7	73.2	0.0
Green Job (Bamboo-based Handicraft)	0.0	0.0	100.0	0.0
Duck rearing	0.0	25.0	75.0	0.0
Maize Cultivation	0.0	6.3	93.8	0.0
Integrated vegetable cultivation	0.0	6.3	85.7	7.9
Mung bean cultivation	0.0	16.7	83.3	0.0
Watermelon cultivation	0.0	16.7	79.2	4.2
Vermicompost	13.8	37.9	48.3	0.0
Saline water fisheries	0.0	12.5	87.5	0.0
Sheep and Duck rearing	0.0	26.5	73.5	0.0
Brackishwater Fish Polyculture	0.0	6.3	93.8	0.0
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber.)	1.4	23.9	74.6	0.0
Sunflower cultivation	45.8	33.3	20.8	0.0
Native Poultry Rearing	0.0	4.2	95.8	0.0
Native Chicken Rearing	6.5	15.1	78.5	0.0
F-1 Calf Rearing	0.0	4.2	95.8	0.0
Total	3.3	20.8	75.1	0.9

The data reveals changes in men's perceptions about women working outside the home after CALO integration, showing varying levels of agreement across different CALOs. For instance, Mung bean cultivation had the highest agreement with 62.5% strongly agreeing that perceptions have positively changed. In contrast, Green Job (Bamboo-based Handicraft) also showed strong positive change with 12.5% strongly agreeing and 75% agreeing. Meanwhile, Native Chicken Rearing and Integrated Agriculture and Poultry indicate more widespread neutrality or disagreement, reflecting mixed perceptions among men regarding women working outside the home.

Table 28: Shifts in men's perceptions of women working outside the home post-CALO integration (Response in %, N=1011)

CALO Name	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Crab fattening	0.0	37.5	0.0	62.5	0.0
Carp fish polyculture	0.0	0.0	24.5	71.4	4.1
Sheep rearing	1.4	15.3	6.9	52.8	23.6
Pig rearing	0.0	25.0	4.2	70.8	0.0
Integrated Agriculture and Poultry	0.0	0.0	19.2	80.8	0.0
Duck and Fish farming	4.8	20.6	14.3	60.3	0.0
Integrated agriculture farming	1.0	24.7	0.0	71.1	3.1
Green Job (Bamboo-based Handicraft)	0.0	6.3	6.3	75.0	12.5
Duck rearing	2.1	14.6	0.0	54.2	29.2
Maize Cultivation	0.0	16.7	2.1	68.8	12.5
Integrated vegetable cultivation	1.6	33.3	12.7	38.1	14.3
Mung bean cultivation	0.0	0.0	0.0	37.5	62.5
Watermelon cultivation	4.2	12.5	0.0	83.3	0.0
Vermicompost	0.0	0.0	3.4	69.0	27.6
Saline water fisheries	0.0	8.3	4.2	87.5	0.0
Sheep and Duck rearing	0.0	18.4	6.1	71.4	4.1
Brackishwater Fish Polyculture	0.0	20.8	12.5	66.7	0.0
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	0.0	29.6	4.2	66.2	0.0
Sunflower cultivation	0.0	0.0	0.0	79.2	20.8
Native Poultry Rearing	0.0	20.8	4.2	66.7	8.3
Native Chicken Rearing	0.0	47.3	2.2	48.4	2.2
F-1 Calf Rearing	0.0	4.2	0.0	95.8	0.0
Total	0.8	19.3	6.7	64.6	8.6

The data reveals varied responses regarding the increase in women's ownership or control of land since engaging in CALOs. For instance, Crab fattening shows a significant agreement with 83.3% of participants noting agreement with no strong agreement. In contrast, Mung bean cultivation and Watermelon cultivation show an overwhelming majority in neutral responses at 95.8% and 91.7%, respectively. Overall, while some CALOs like Pig rearing and Green Job (Bamboo-based Handicraft) show substantial agreement on increased land ownership among women, others like Integrated Agriculture and Poultry and Saline water fisheries indicate considerable neutrality or disagreement.

Table 29: Increase in women's ownership or control of land post-CALO engagement (Response in %, N=1011)

CALO Name	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Crab fattening	0.0	0.0	16.7	83.3	0.0
Carp fish polyculture	0.0	12.2	61.2	26.5	0.0
Sheep rearing	4.2	18.1	31.9	45.8	0.0
Pig rearing	0.0	16.7	12.5	70.8	0.0
Integrated Agriculture and Poultry	15.1	49.3	30.1	5.5	0.0
Duck and Fish farming	20.6	7.9	28.6	39.7	3.2
Integrated agriculture farming	1.0	46.4	8.2	43.3	1.0
Green Job (Bamboo-based Handicraft)	0.0	18.8	6.3	75.0	0.0
Duck rearing	0.0	35.4	47.9	16.7	0.0
Maize Cultivation	0.0	12.5	20.8	66.7	0.0
Integrated vegetable cultivation	0.0	9.5	39.7	46.0	4.8
Mung bean cultivation	0.0	0.0	95.8	4.2	0.0
Watermelon cultivation	0.0	8.3	91.7	0.0	0.0
Vermicompost	0.0	17.2	75.9	6.9	0.0
Saline water fisheries	0.0	50.0	45.8	4.2	0.0
Sheep and Duck rearing	2.0	75.5	12.2	10.2	0.0
Brackishwater Fish Polyculture	0.0	35.4	6.3	58.3	0.0
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	0.0	42.3	16.9	39.4	1.4
Sunflower cultivation	0.0	45.8	54.2	0.0	0.0
Native Poultry Rearing	8.3	33.3	0.0	58.3	0.0
Native Chicken Rearing	11.8	16.1	11.8	60.2	0.0
F-1 Calf Rearing	0.0	0.0	25.0	75.0	0.0
Total	4.2	27.5	29.3	38.4	0.7

The analysis reveals significant positive changes in the socio-economic status of women across various agro-ecological zones due to their participation in CALO activities. These initiatives have notably enhanced women's access to financial resources, educational opportunities, and leadership roles, contributing to an increased presence in community decision-making and economic activities. Furthermore, CALOs have played a pivotal role in improving community respect for women's opinions and involvement in social networks, underscoring the transformative impact of these interventions in promoting gender equity and empowering women within their local contexts.

Chapter 4

Evaluation of CALOs in terms of Resilience to climate change

4.1 Climatic conditions and vulnerability analysis

4.1.1 Active Tista Floodplain (Zone 2) - Kurigram

Geographical and Environmental Context

The Active Tista Floodplain in the district of Kurigram, including upazilas such as Char Rajibpur, Roumari, and Chilmari, features a landscape dominated by the dynamics of the Tista, Dharla, and Dudhkumar rivers. This area encompasses about 830 square kilometers of mainly non-calcareous alluvium soils with moderate acidity and mixed fertility levels. Its unique topography of low ridges, inter-ridge depressions, and changing river channels presents specific challenges for land use and agriculture.

Climatic Conditions

Characterized by a subtropical monsoon climate, this region experiences substantial rainfall during the monsoon months, leading to extensive and repeated flooding. These floods are both a boon and bane, as they enrich the soil with sediments but also cause significant erosion and land use disruption. The winter season brings cooler, drier weather that significantly affects agricultural cycles and soil moisture levels.

Vulnerabilities

1. **Agricultural Impact:** The region's dependence on agriculture makes it particularly vulnerable to the timing and intensity of monsoon rains, which directly affect crop cycles and yields. Historical flood events have led to soil damage, loss of seedlings, and substantial economic losses in agriculture.
2. **Livestock and Fisheries:** Extensive flooding impacts fodder availability and the health of livestock, increasing the incidence of diseases. Floodwater often damages fish habitats and pond banks, affecting both cultured and natural fisheries.
3. **Infrastructure and Economic Stability:** Repeated flooding disrupts transportation and damages infrastructure, including roads and bridges essential for market access. Economic activities, particularly in the industrial sector such as garment factories, have suffered extensive damage due to flooding.
4. **Public Health:** The increase in waterborne diseases, sanitation challenges, and the rise in incidents like snake bites during floods pose significant public health risks.

[5]Ministry of Agricultutre 3.1 agro ecological zones, MOA. Available at: https://moa.portal.gov.bd/ sites/default/files/files/moa.portal.gov.bd/page/be7e86a4_cfb0_48a8_9ae2_e2481ba35b60/Chapter-3_Resource_Base.pdf.

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Implemented CALOs in This Region by LoGIC Project

The LoGIC project has introduced several Climate Adaptive Livelihood Options (CALOs) to enhance resilience against these vulnerabilities:

- **Agricultural Innovations:** Stress-tolerant vegetable cultivation (e.g., brinjal, rice) and maize cultivation aim to maintain agricultural productivity despite variable water levels.
- **Livestock and Poultry Development:** Initiatives like native chicken rearing and F-1 calf rearing not only diversify income sources but also contribute to food security.
- **Sustainable Practices:** Integrated agriculture and vermicompost projects improve soil health and support sustainable crop production.
- **Fisheries Management:** Promoting practices like the establishment of Fish Sanctuaries helps conserve local fish varieties and ensures year-round availability, despite environmental stresses.

Challenges and Further Actions

While these CALOs offer significant potential to mitigate some of the climatic impacts, challenges remain in terms of scalability, community adoption, and long-term sustainability. Continuous assessment and adaptation of these livelihood options, alongside infrastructural improvements and enhanced public health strategies, are crucial for building resilience in the Active Tista Floodplain.

4.1.2 Sylhet Basin (Zone 21) - Sunamganj

Geographical and Environmental Context

The Sylhet Basin encompasses 4,573 sq km of the lower western side of the Surma-Kushiyara floodplain, with irregular relief near rivers and a mix of grey silty clay loams and clay loam soils that dry seasonally. These soils are moderately acidic with medium to high fertility levels. The Haor Region, characterized by its unique wetland ecosystem, spans several districts including Sylhet, Sunamganj, and Kishoreganj, covering about 0.86 million ha of depression area. This region is subject to seasonal inundation lasting 7-8 months, profoundly impacting the local agriculture and ecology.

Climatic Conditions

The Sylhet Basin and Haor areas are prone to heavy rainfall, especially from upstream catchment areas, resulting in frequent flash floods during the pre-monsoon season (April-May). These floods are critical in shaping the local agricultural timeline, often destroying crops right before harvest, particularly the boro rice. The variability in rainfall and the impact of climate change contribute to these challenges, exacerbating the vulnerability of the region to water-related disasters.

Vulnerabilities

1. **Agricultural Impact:** Flash floods severely disrupt the agricultural cycles, particularly affecting the only annual crop—boro rice—sown in the Haor regions. This leads to significant economic losses and food insecurity.
2. **Fisheries:** The local fish population and biodiversity suffer due to habitat destruction and changes in water levels and quality. Overfishing and inadequate policy enforcement further stress the aquatic ecosystems.
3. **Livestock:** Seasonal floods and other climate-related hazards impact livestock health and availability of fodder, complicating rearing and management practices, particularly during prolonged inundation.

4. **Human Settlements and Health:** The population faces increased health risks and displacement due to flooding, with waterborne diseases and physical displacement being common. The region's dependence on natural resources also heightens its socio-economic vulnerabilities.

Implemented CALOs in this Region by LoGIC Project

The LoGIC project has introduced several adaptive livelihood strategies to mitigate the impact of climatic vulnerabilities:

- **Aquaculture and Poultry Integration:** Duck and fish farming, as well as integrated agriculture and poultry systems, have been promoted to diversify income sources and enhance food security.
- **Resilient Crop Varieties:** Introduction of short-duration crop varieties that can withstand the flooding period, thus securing agricultural output.
- **Infrastructure Enhancements:** Construction of submersible roads and improved water management systems help maintain connectivity and reduce flood damage.
- **Community Engagement and Capacity Building:** Training and support for local communities in adopting sustainable practices and enhancing resilience against climatic shocks.

Challenges and Further Actions

While these initiatives offer pathways to adapt to the challenging conditions, persistent issues like land use conflicts, inadequate infrastructure, and the need for more comprehensive policy enforcement remain. Strengthening the adaptive capacity of both human and ecological systems in these regions is crucial. This involves not only improving physical infrastructure but also fostering a community-based approach to managing natural resources and hazards.

4.1.3 Ganges Tidal Floodplain (Zone 13) - Khulna, Bagerhat, Barguna, Patuakhali

Geographical and Environmental Context

The Ganges Tidal Floodplain spans approximately 17,066 sq km in the southwest of Bangladesh, characterized by its extensive tidal land with smooth relief and significant areas of salinity. The major soil types include non-calcareous grey floodplain soils, which are predominantly acidic at the surface but range from neutral to mildly alkaline in the subsoils. The Sundarbans area within this zone has alkaline soil. The general fertility level is high, benefiting from the tidal flux which deposits nutrient-rich silt, enhancing the organic matter content of the soils.

Climatic Conditions

This region is influenced heavily by the monsoon, with tidal activities shaping the landscape and agricultural patterns. Flooding during the monsoon season is common, affecting the riverbanks which stand only about a meter above the level of adjoining basins. The area's climatic conditions, coupled with its tidal nature, lead to unique challenges, including soil salinity and frequent inundations that modify the land usability annually.

Vulnerabilities

1. **Agricultural Disruptions:** The frequent and intense flooding coupled with high salinity levels pose significant challenges to traditional farming practices. Crop yields are often inconsistent and susceptible to the changing patterns of salinity and waterlogging.

2. **Infrastructure and Economic Impact:** Critical infrastructures such as roads and industries, particularly the garment sector, are vulnerable to flooding, leading to substantial economic disruptions and job losses.

3. **Public Health Risks:** Increased incidences of waterborne diseases, including diarrhea and ailments caused by snake bites, are prominent during monsoon floods. The lack of clean drinking water and adequate sanitation facilities exacerbates these health issues.

4. **Environmental Degradation:** Flooding contributes to significant ecological impacts, including sediment deposition that affects the river's capacity and biodiversity loss due to changes in aquatic habitats.

Implemented CALOs in This Region by LoGIC Project

To address these vulnerabilities, the LoGIC project has implemented various adaptive livelihood strategies tailored to the unique conditions of the Ganges Tidal Floodplain:

- Aquaculture Innovations: Brackishwater and carp fish polyculture, along with crab fattening, leverage the natural tidal conditions to enhance fish production, providing resilient income sources.
- Agricultural Adaptations: Introduction of stress-tolerant vegetable varieties such as brinjal, rice, and red-amaranth, alongside sunflower and watermelon cultivation, are designed to cope with the saline conditions and irregular water supply.
- Integrated Farming Systems: Combining duck and fish farming, integrated agriculture and poultry, and pig rearing with agroforestry practices ensures multiple revenue streams and reduces risk.
- Sustainable Practices: Vermicompost production and nursery development promote environmental sustainability and improve soil health.
- Livelihood Diversification: Initiatives like native poultry rearing and the creation of green jobs through bamboo-based handicrafts provide alternative income opportunities, reducing dependency on traditional agriculture.

Challenges and Further Actions

Despite these initiatives, challenges such as land use conflicts, inadequate infrastructure resilience, and the need for more effective water management persist. Future efforts need to focus on enhancing infrastructure, implementing comprehensive flood management strategies, and further developing sustainable agricultural practices to mitigate the impact of climatic changes and ensure the long-term viability of the region's economy and environment.

4.1.4 Young Meghna Estuarine Floodplain (Zone 18) - Bhola

Geographical and Environmental Context

This region, encompassing 9,269 sq km, is characterized by young alluvial lands around the Meghna estuary with soils that are predominantly grey to olive, deep calcareous silt loam, and silty clay loams. These soils, which are stratified either throughout or at shallow depths, exhibit mild alkalinity and medium general fertility but are low in nitrogen and organic matter.

The coastal areas, frequently impacted by cyclones, storm surges, and sea level rise, experience significant environmental stress. The salinity intrusion and long-term water-logging in low-lying areas like the beels of Khulna and Jessore are major concerns that affect both agriculture and daily living conditions.

Climatic Conditions

The estuarine and coastal zones are heavily influenced by seasonal monsoons that bring significant rainfall and tidal fluctuations. The estuary area benefits from nutrient-rich silt deposits that are vital for agricultural fertility but also faces challenges from flooding. The coastal region, meanwhile, deals with the dual threat of cyclonic activities and rising sea levels, which exacerbate salinity issues in the soil and groundwater.

Vulnerabilities

1. **Agriculture:** In this region, agricultural practices are frequently disrupted by salinity fluctuations and water logging. The coastal areas, in particular, face reduced crop yields due to increased soil and water salinity and changing rainfall patterns, which impact the traditional cropping schedules and viability.
2. **Water Resources:** Safe drinking water scarcity is a critical issue, compounded by the salinity intrusion into freshwater sources. The frequent and intense cyclonic events lead to storm surges that contaminate freshwater bodies and agricultural lands with saline water.
3. **Human Settlements and Livelihoods:** The residents of this region are at high risk from natural disasters, which disrupt livelihoods, damage property, and lead to displacement.

Implemented CALOs in This Region by LoGIC Project

To mitigate these vulnerabilities, several adaptive livelihood strategies have been implemented:

- **Aquaculture and Horticulture Integration:** Techniques like duck and fish farming, carp fish polyculture, and the cultivation of stress-tolerant vegetables (e.g., brinjal, rice, red-amaranth, cucumber) are adapted to fluctuating water and salinity levels.
- **Integrated Farming Systems:** Combining different agricultural and aquaculture practices, such as integrated agriculture and poultry, helps to diversify income and reduce risk.
- **Sustainable Agricultural Practices:** The introduction of integrated vegetable cultivation and the use of vermicompost aim to improve soil health and crop yields in saline-prone areas.
- **Livestock Rearing:** Raising native chicken varieties that are more adaptable to the local conditions helps to sustain poultry production despite environmental stresses.

Challenges and Further Actions

While these CALOs have provided pathways for adaptation, continuous challenges like infrastructure degradation, water management inefficiencies, and the need for enhanced community resilience remain. Future efforts should focus on improving flood defense systems, expanding rainwater harvesting, promoting sustainable land use practices, and enhancing early warning systems for cyclones and floods to build long-term resilience in these vulnerable regions.

4.1.5 Northern and Eastern Hills (Zone 29) - Chattogram

Geographical and Environmental Context

Covering approximately 18,171 sq km, this region features complex relief with steep slopes and a few flat hill summits. The predominant soil type is brown hill soil, characterized by low organic matter content and general fertility. These conditions challenge traditional agriculture but also present unique opportunities for specific crop and livestock adaptations. This region experiences frequent landslides, drying up of springs, and the impact of cyclones and storm surges. The area's complex topography and variable climatic conditions significantly influence local livelihoods and necessitate targeted adaptation strategies to mitigate climate risks.

Climatic Conditions

Both regions experience varied climatic impacts primarily characterized by high rainfall intensity, which leads to significant soil erosion and landslides, especially in the CHT. The drying up of streams during the dry season (October – May) and increasing landslide incidents due to intense rainfall exacerbate the challenges in these hilly areas.

Vulnerabilities

Water Resources: Declining groundwater levels and reduced surface water capacities due to siltation and increased water pollution are major concerns, especially in the CHT. These issues are compounded by inadequate water infrastructure, leading to waterlogging in lowlands and affecting water quality and availability.

1. **Agriculture:** Increased rainfall and temperature variability cause severe soil erosion, landslides, and disruption in traditional farming schedules, leading to crop losses and decreased agricultural productivity.
2. **Biodiversity and Ecosystem Health:** The regions suffer from biodiversity loss due to habitat degradation and changing climatic conditions, impacting local flora and fauna, including forest animals and migratory birds.
3. **Human Settlements and Livelihoods:** The residents face increased risks from natural disasters, such as landslides and cyclones, which damage property, disrupt livelihoods, and lead to displacement.

Proposed CALOs for These Regions

Given the specific challenges of the Northern and Eastern Hills and the CHT, the following Climate Adaptive Livelihood Options could be proposed:

- **Agroforestry and Permaculture:** Integrating tree planting with crop and livestock farming to reduce soil erosion, enhance biodiversity, and improve water retention and soil fertility.
- **Rainwater Harvesting and Water Management Systems:** Developing community-based rainwater harvesting and gravity flow systems to address water scarcity and support irrigation needs during dry periods.
- **Resilient Crop Varieties:** Introducing and promoting crop varieties that are resistant to variable temperatures, pests, and diseases, and suitable for the unique soil conditions of the hills.
- **Diversified Livelihood Strategies:** Encouraging non-agricultural income sources such as eco-tourism, handicrafts, and other small-scale industries that leverage the unique cultural and natural resources of the regions.

The Northern and Eastern Hills face distinct climatic and ecological challenges that require tailored adaptation strategies. The proposed CALOs aim to enhance resilience by improving water management, promoting sustainable agricultural practices, and strengthening community disaster preparedness. Implementing these options will require collaboration between local communities, government agencies, and international partners to ensure sustainability and effectiveness.

4.2 Effectiveness of CALOs in reducing climate-related risks in terms of adaptability

Climate change has a beneficial impact on agricultural production or crop yields in wealthier nations located at higher or mid-latitudes. Conversely, countries with lower incomes and situated at lower latitudes experience adverse effects on their agricultural sector's productivity . As the

majority of South Asian nations belong to the category of low-income and lower-latitude countries, frequent occurrences of climate change adversely affect the food security of the majority of people in these areas .The absence of the ability to adjust to climate change hampers impoverished farmers in Bangladesh from expanding the range of crops they grow in areas resilient to drought. Strategies for adapting to climate change can mitigate the risks associated with unexpected weather patterns, ultimately enhancing food security, increasing income, and securing livelihoods for farmers .

This chapter delves into the effectiveness of CALOs in mitigating climate-related risks, with a central focus on their adaptability. Through a comprehensive analysis encompassing zone-wise climatic conditions and vulnerability profiles, we aim to assess the viability of CALOs as integral components of resilience-building strategies. By considering the diverse challenges posed by regional climatic variations and associated vulnerabilities, alongside evaluating the adaptability of CALOs across different climatic zones.

Table 30: Percentage of respondent's perception of their CALO being adaptive to extreme temperature and drought. (Response in %, N=1011)

CALO	Yes	To some extent	No	Not applicable
Crab fattening	50.0	50.0	0.0	0.0
Carp fish polyculture	0.0	85.7	12.2	2.0
Sheep rearing	31.9	52.8	1.4	13.9
Pig rearing	45.8	25.0	29.2	0.0
Integrated Agriculture and Poultry	1.4	82.2	16.4	0.0
Duck and Fish farming	20.6	55.6	23.8	0.0
Integrated agriculture farming	4.1	84.5	11.3	0.0
Green Job (Bamboo-based Handicraft)	87.5	12.5	0.0	0.0
Duck rearing	18.8	75.0	6.3	0.0
Maize Cultivation	22.9	45.8	31.3	0.0
Integrated vegetable cultivation	49.2	49.2	1.6	0.0
Mung bean cultivation	58.3	41.7	0.0	0.0
Watermelon cultivation	66.7	0.0	0.0	33.3
Vermicompost	62.1	37.9	0.0	0.0
Saline water fisheries	25.0	75.0	0.0	0.0
Sheep and Duck rearing	6.1	91.8	2.0	0.0
Brackish water Fish Polyculture	25.0	41.7	12.5	20.8
Stress Tolerant Vegetable (brinjal, rice,red-amaranth, cucumber .)	11.3	87.3	1.4	0.0
Sunflower cultivation	0.0	0.0	100.0	0.0
Native Poultry Rearing	12.5	79.2	8.3	0.0
Native Chicken Rearing	10.8	72.0	17.2	0.0
F-1 Calf Rearing	37.5	62.5	0.0	0.0
Total	22.6	62.6	12.0	2.9

In the Ganges Tidal Floodplain, several CALOs have shown effectiveness in adapting to extreme temperatures and drought conditions, addressing vulnerabilities such as flooding and soil salinity. For example, crab fattening (50.0%), Pig rearing (45.8%), Green Jobs (87.5%), Integrated vegetable cultivation (49.2%), Mung bean cultivation (58.3%) watermelon cultivation (66.7%) and Vermicompost (62.1%) have demonstrated high adaptability rates, suggesting their efficacy in mitigating climate-related risks. These CALOs leverage the unique environmental conditions of the floodplain to provide alternative livelihood options and enhance resilience against climatic challenges. On the other hand, 100% of the sunflower cultivation farmers said this CALO is not adaptive to extreme temperature and drought. In the Young Meghna Estuarine Floodplain, CALOs like carp fish polyculture (85.7%), integrated Agriculture and Poultry (82.2%), Duck and Fish Farming (55.6%), Integrated Agricultural farming (84.5%) and stress-tolerant vegetable cultivation (87.3%) farmers have said that these CALOs are to some extent adapting to extreme temperature and drought conditions. This provides a resilient agricultural practice in the face of changing climate patterns. In the Active Tista Floodplain, CALOs such as integrated vegetable cultivation (49.2%) and vermicompost production (62.1%) farmers have said these CALOs demonstrated effectiveness in adapting to climatic conditions and vulnerabilities. Integrated vegetable cultivation offers a sustainable approach to cope with variable water levels and soil erosion during floods. Similarly, vermicompost production improves soil health and supports sustainable crop production. Here, 37.5% F-1 Calf Rearing farmers said this project is quite adaptive to extreme temperature and drought. These CALOs play a crucial role in enhancing resilience in agriculture and mitigating the impacts of climate change. In the Sylhet Basin, CALOs like integrated agriculture and poultry systems (82.2%) and duck rearing (75%) farmers said these CALOs are to some extent effective in adapting to extreme temperature and drought conditions. Integrated agriculture and poultry systems provide a holistic approach to agricultural sustainability, diversifying income sources and reducing vulnerability to climate-related risks. Similarly, duck rearing wetland ecosystems to enhance food security and livelihoods. These CALOs contribute to building resilience in the face of climate change and environmental vulnerabilities.

[8]Lee, H.-L. The impact of climate change on global food supply and demand, food prices, and land use. Paddy Water Environ. 2009,7, 321–331.
[9]Barros, V.R.; Field, C.B. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects; Cambridge University Press: New York, NY, USA, 2014.
[10]https://www.sciencedirect.com/science/article/abs/pii/S0301479717305777

Table 31: Percentage of respondent's perception of their CALO being effective in coping with significant fluctuations in temperature. (Response in %, N=1011)

CALO	Yes	To some extent	No	Not applicable
Crab fattening	50.0	50.0	0.0	0.0
Carp fish polyculture	2.0	85.7	12.2	0.0
Sheep rearing	29.2	54.2	1.4	15.3
Pig rearing	41.7	58.3	0.0	0.0
Integrated Agriculture and Poultry	0.0	83.6	16.4	0.0
Duck and Fish farming	15.9	60.3	23.8	0.0
Integrated agriculture farming	11.3	83.5	5.2	0.0
Green Job (Bamboo-based Handicraft)	37.5	62.5	0.0	0.0
Duck rearing	22.9	72.9	4.2	0.0
Maize Cultivation	2.1	91.7	6.3	0.0
Integrated vegetable cultivation	46.0	54.0	0.0	0.0
Mung bean cultivation	54.2	45.8	0.0	0.0
Watermelon cultivation	66.7	0.0	0.0	33.3
Vermicompost	51.7	48.3	0.0	0.0
Saline water fisheries	25.0	75.0	0.0	0.0
Sheep and Duck rearing	4.1	93.9	2.0	0.0
Brackishwater Fish Polyculture	4.2	77.0	8.3	10.4
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	15.5	83.1	1.4	0.0
Sunflower cultivation	0.0	20.8	79.2	0.0
Native Poultry Rearing	4.2	91.7	4.2	0.0
Native Chicken Rearing	9.7	77.4	12.9	0.0
F-1 Calf Rearing	37.5	62.5	0.0	0.0
Total	19.4	70.1	8.1	2.4

In the Ganges Tidal Floodplain, where vulnerabilities include disruptions to traditional farming due to high salinity levels and the environmental impact of flooding, the implemented CALOs have shown mixed effectiveness in coping with significant fluctuations in temperature. For instance, crab fattening and carp fish polyculture show varied adaptability, with 50.0% and 2.0% of respondents respectively perceiving effectiveness in coping. However, Mung bean cultivation and Watermelon cultivation display higher adaptability rates at 54.2% and 66.7% respectively. Also, around 75% saline water fisheries, 93.9% Sheep and Duck rearing and 91.7% Native poultry rearing farmers said their CALOs are to some extent effective in coping with temperature fluctuation. These results suggest that while some CALOs may struggle to cope with temperature fluctuations, others, particularly those involving livestock and agricultural diversification, demonstrate more promising outcomes.

In the Young Meghna Estuarine Floodplain, vulnerability stems from coastal impacts like salinity intrusion and waterlogging. Here, CALOs such as brackish water fish polyculture and stress-tolerant vegetable cultivation show moderate adaptability, with 77.1% and 83.1% of respondents perceiving to some extent effectiveness, respectively. In the Active Tista Floodplain, which faces vulnerabilities such as agricultural dependency and public health risks during floods, CALOs like integrated agriculture farming and vermicompost production demonstrate promising adaptability, with 83.5% and 51.7% of respondents respectively perceiving effectiveness. Conversely, maize cultivation shows lower adaptability at 2.1%. These results suggest that while some CALOs effectively cope with

temperature fluctuations, others may need adjustments to better address the region's specific vulnerabilities. In the Sylhet Basin, vulnerability arises from flash floods and habitat destruction affecting agricultural cycles and fish populations. CALOs such as Duck rearing and sheep and Duck rearing exhibit moderate adaptability, with 72.9% and 93.9% of respondents respectively perceiving effectiveness. Meanwhile, integrated agriculture and poultry and native chicken rearing show moderate adaptability rates at 83.6% and 77.4% respectively. These findings highlight the importance of diversifying livelihood strategies to enhance resilience to climate-related risks in the region.

Table 32: Percentage of respondent's perception of their CALO being able to manage prolonged dry periods or drought effectively. (Response in %, N=1011)

CALO	Yes	To some extent	No	Not applicable
Crab fattening	54.2	45.8	0.0	0.0
Carp fish polyculture	4.1	77.6	16.3	2.0
Sheep rearing	25.0	59.7	1.4	13.9
Pig rearing	29.2	25.0	45.8	0.0
Integrated Agriculture and Poultry	0.0	82.2	17.8	0.0
Duck and Fish farming	17.5	58.7	23.8	0.0
Integrated agriculture farming	8.2	86.6	5.2	0.0
Green Job (Bamboo-based Handicraft)	37.5	62.5	0.0	0.0
Duck rearing	20.8	72.9	4.2	2.1
Maize Cultivation	0.0	91.7	8.3	0.0
Integrated vegetable cultivation	50.8	46.0	3.2	0.0
Mung bean cultivation	33.3	66.7	0.0	0.0
Watermelon cultivation	66.7	0.0	0.0	33.3
Vermicompost	44.8	55.2	0.0	0.0
Saline water fisheries	25.0	75.0	0.0	0.0
Sheep and Duck rearing	4.1	95.9	0.0	0.0
Brackishwater Fish Polyculture	8.3	72.9	14.6	4.2
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	12.7	85.9	1.4	0.0
Sunflower cultivation	0.0	0.0	100.0	0.0
Native Poultry Rearing	4.2	87.5	8.3	0.0
Native Chicken Rearing	11.8	73.1	15.1	0.0
F-1 Calf Rearing	33.3	66.7	0.0	0.0
Total	18.3	68.7	10.8	2.2

From the above table it is found that, in the Ganges Tidal Floodplain, where vulnerabilities include disruptions to traditional farming due to high salinity levels and frequent flooding, the CALO projects exhibit varying degrees of effectiveness in managing prolonged dry periods or drought. For example, crab fattening and watermelon cultivation show promising adaptability, with 54.2% and 66.7% of respondents respectively perceiving effectiveness. Conversely, pig rearing demonstrates lower adaptability, with only 45.8% of respondents perceiving no adaptability and for sunflower cultivation 100% of the respondents perceiving no adaptability. On the other hand, 62.5% green job holders, 66.7% mung bean cultivators, 75% saline water fish farmers, 87.5% native poultry farmers perceive their CALOs to be adaptive to some extent to drought and dry period. In the Young Meghna Estuarine

Floodplain, which faces vulnerabilities such as salinity intrusion and waterlogging, CALOs like brackish water fish polyculture and stress-tolerant vegetable cultivation show moderate adaptability, with 72.9% and 85.9% of respondents respectively perceiving effectiveness. In the Active Tista Floodplain, which is vulnerable to floods impacting agricultural cycles and livestock health, CALOs such as integrated agriculture farming and vermicompost production exhibit moderate adaptability, with 86.6% and 55.2% of respondents respectively perceiving effectiveness. Also, around 33.3 % F-1 calf rearing farmers said this is adaptive and another 66.7% of the F-1 calf rearing farmers said this is adaptive to some extent. However, sheep rearing shows lower adaptability, with only 25.0% of respondents perceiving effectiveness. These findings underscore the importance of implementing diversified livelihood strategies to effectively manage prolonged dry periods and reduce vulnerability to climate-related risks. In the Sylhet Basin, where vulnerabilities include disruptions to agricultural cycles and habitat destruction affecting fish populations, CALOs like duck rearing and sheep and duck rearing display moderate adaptability, with 72.9% and 95.9% of respondents respectively perceiving effectiveness. These results highlight the significance of promoting resilient agricultural practices and livestock rearing to enhance resilience to prolonged dry periods in the region.

Table 33: Percentage of respondent's perception of their CALO being adaptive to changes in the intensity and frequency of rainfall. (Response in %, N=1011)

CALO	Yes	To some extent	No	Not applicable
Crab fattening	54.2	41.7	4.2	0.0
Carp fish polyculture	2.0	73.5	22.4	2.0
Sheep rearing	22.2	61.1	1.4	15.3
Pig rearing	33.3	58.3	8.3	0.0
Integrated Agriculture and Poultry	15.1	64.4	20.5	0.0
Duck and Fish farming	22.2	55.6	22.2	0.0
Integrated agriculture farming	11.3	88.7	0.0	0.0
Green Job (Bamboo-based Handicraft)	31.3	68.8	0.0	0.0
Duck rearing	10.4	81.3	8.3	0.0
Maize Cultivation	4.2	91.7	4.2	0.0
Integrated vegetable cultivation	47.6	39.7	12.7	0.0
Mung bean cultivation	12.5	87.5	0.0	0.0
Watermelon cultivation	62.5	4.2	0.0	33.3
Vermicompost	48.3	51.7	0.0	0.0
Saline water fisheries	25.0	75.0	0.0	0.0
Sheep and Duck rearing	4.1	95.9	0.0	0.0
Brackishwater Fish Polyculture	14.6	70.8	4.2	10.4
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	9.9	90.1	0.0	0.0
Sunflower cultivation	0.0	8.3	91.7	0.0
Native Poultry Rearing	8.3	83.3	8.3	0.0
Native Chicken Rearing	15.1	73.1	11.8	0.0
F-1 Calf Rearing	33.3	66.7	0.0	0.0
Total	19.2	68.9	9.4	2.5

The above table presents respondents' perceptions of the adaptability of various CALOs to changes in the intensity and frequency of rainfall. It provides valuable insights into the effectiveness of these CALOs in mitigating climate-related risks and vulnerabilities. Some CALOs demonstrate significant adaptability, indicating their potential to address climate challenges effectively. For example, Crab fattening, watermelon cultivation and vermicompost production exhibit high adaptability rates of 54.2%, 62.5% and 48.3%, respectively. These findings suggest that these practices are well-suited to cope with fluctuations in rainfall intensity and frequency, potentially reducing vulnerability to droughts or excessive rainfall. On the other hand, CALOs such as sheep rearing (61.1%), integrated agriculture and poultry (64.4%), duck and fish rearing (55.6%), integrated agricultural farming (88.7%), maize cultivation (91.7%), mung bean cultivation (87.5%) and farmers of other CALOs said these CALOs are somewhat adaptive to the intensity and frequency of rainfall. Also, 91.7% of the sunflower cultivators said its not adaptive to the intensity of the rain fall. These approaches combine diverse agricultural practices, enabling farmers to diversify their income sources and better withstand climate variability. Overall, only 10.8 % of the farmers said their CALOs are not adaptive to the frequency of

rainfall. The table underscores the importance of promoting and implementing adaptive CALOs tailored to specific climatic conditions and vulnerabilities. Practices like watermelon cultivation, vermicompost production, integrated agriculture farming, and integrated livestock rearing emerge as viable options for enhancing resilience to climate-related risks associated with changes in rainfall intensity and frequency. However, CALOs with lower adaptability rates, such as carp fish polyculture and maize cultivation, may require further support or alternative strategies to improve their effectiveness in mitigating climate risks.

Table 34: Percentage of respondent's perception of their CALO being flexible enough to adapt to changing seasonal patterns. (Response in %, N=1011)

CALO	Yes	To some extent	No	Not applicable
Crab fattening	54.2	45.8	0.0	0.0
Carp fish polyculture	4.1	63.3	32.7	0.0
Sheep rearing	22.2	54.2	8.3	15.3
Pig rearing	29.2	58.3	12.5	0.0
Integrated Agriculture and Poultry	0.0	78.1	21.9	0.0
Duck and Fish farming	17.5	58.7	23.8	0.0
Integrated agriculture farming	10.3	87.6	2.1	0.0
Green Job (Bamboo-based Handicraft)	50.0	50.0	0.0	0.0
Duck rearing	12.5	83.3	2.1	2.1
Maize Cultivation	10.4	87.5	2.1	0.0
Integrated vegetable cultivation	46.0	47.6	6.3	0.0
Mung bean cultivation	12.5	87.5	0.0	0.0
Watermelon cultivation	62.5	4.2	0.0	33.3
Vermicompost	48.3	51.7	0.0	0.0
Saline water fisheries	25.0	75.0	0.0	0.0
Sheep and Duck rearing	2.0	93.9	4.1	0.0
Brackishwater Fish Polyculture	2.1	75.0	10.4	12.5
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	14.1	84.5	0.0	1.4
Sunflower cultivation	0.0	12.5	87.5	0.0
Native Poultry Rearing	12.5	79.2	8.3	0.0
Native Chicken Rearing	17.2	69.9	12.9	0.0
F-1 Calf Rearing	33.3	66.7	0.0	0.0
Total	18.2	68.6	10.5	2.7

The above table provides insights into the adaptability of various CALOs to changing seasonal patterns, reflecting their effectiveness in mitigating climate-related risks and vulnerabilities. Some CALOs demonstrate significant flexibility, indicating their potential to cope with evolving climatic conditions. For instance, crab fattening, Green Job (Bamboo-based Handicraft), and Watermelon cultivation exhibit high adaptability rates of 54.2%, 50.0%, and 62.5%, respectively. These practices are well-suited to adapt to shifts in seasonal patterns, potentially reducing vulnerability to climatic uncertainties. Conversely, CALOs such as Carp fish polyculture and sunflower cultivation show lower adaptability rates, at 32.7% and 87.5% farmers said their CALOs are not adaptable to changing seasonal patterns respectively, suggesting a need for further support or alternative strategies to enhance their

effectiveness. 87.6 % Integrated agriculture farmers, 78.1% integrated agriculture and poultry farmers, 58.7% duck and fish farmers, 83.3% duck farmers, 87.5% maize and mung bean cultivators, 66.7 % F- calf farmers said their CALOs are somewhat adaptive to changing seasonal pattern, showcasing their capacity to adjust to changing seasonal patterns effectively. The table highlights the importance of promoting and implementing adaptive CALOs tailored to specific climatic conditions, with practices like Watermelon cultivation, Vermicompost production, and Integrated agriculture farming emerging as viable options for enhancing resilience to climate-related risks associated with shifting seasonal patterns. However, CALOs with lower adaptability rates, such as Carp fish polyculture and Sunflower cultivation, may require additional strategies to bolster their adaptability and effectiveness in mitigating climate risks. Overall, only 10.5% of respondents perceive their CALOs as not flexible enough to adapt to changing seasonal patterns, emphasizing the significance of promoting adaptable agricultural practices tailored to local climatic conditions and vulnerabilities.

Table 35: Percentage of respondent's perception of their CALO able to cope well with saline intrusion. (Response in %, N=1011)

CALO	Yes	To some extent	No	Not applicable
Crab fattening	54.2	45.8	0.0	0.0
Carp fish polyculture	0.0	26.5	67.3	6.1
Sheep rearing	15.3	18.1	9.7	56.9
Pig rearing	25.0	25.0	20.8	29.2
Integrated Agriculture and Poultry	0.0	39.7	58.9	1.4
Duck and Fish farming	7.9	54.0	38.1	0.0
Integrated agriculture farming	7.2	42.3	17.5	33.0
Green Job (Bamboo-based Handicraft)	93.8	6.3	0.0	0.0
Duck rearing	2.1	29.2	20.8	47.9
Maize Cultivation	4.2	64.6	12.5	18.8
Integrated vegetable cultivation	6.3	20.6	19.0	54.0
Mung bean cultivation	0.0	54.2	45.8	0.0
Watermelon cultivation	0.0	0.0	0.0	100.0
Vermicompost	48.3	13.8	0.0	37.9
Saline water fisheries	25.0	70.8	4.2	0.0
Sheep and Duck rearing	0.0	53.1	14.3	32.7
Brackishwater Fish Polyculture	47.9	52.1	0.0	0.0
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	2.8	63.4	4.2	29.6
Sunflower cultivation	0.0	0.0	100.0	0.0
Native Poultry Rearing	12.5	58.3	29.2	0.0
Native Chicken Rearing	9.7	34.4	20.4	35.5
F-1 Calf Rearing	0.0	54.2	0.0	45.8
Total	12.0	39.1	22.7	26.3

The above table presents respondents' perceptions of the adaptability of various CALOs to cope with saline intrusion in the Ganges Tidal Floodplain area, shedding light on their effectiveness in mitigating climate-related risks and vulnerabilities specific to this region. CALOs such as Crab fattening, Green Job (Bamboo-based Handicraft), Vermicompost and Brackish water fish polyculture demonstrate notable adaptability, with 54.2%, 93.8%, 48.3% and 47.9% respectively, indicating their ability to withstand saline intrusion effectively. These findings suggest that these practices are well-suited to address the challenges posed by high salinity levels in the region, potentially reducing vulnerability to disruptions in traditional farming caused by soil salinity. On the other hand, CALOs like 67.3% Carp fish

polyculture, 58.9 Integrated agriculture and poultry, 38.1 % Duck and fish farming, 45.8% Mung bean farmers said these CALOs are unable cope well with saline intrusion. CALOs such as Sheep rearing, Integrated Agriculture and Poultry, and Duck and Fish farming show mixed adaptability rates, indicating varying degrees of effectiveness in managing saline intrusion. For instance, Sheep rearing has a relatively low adaptability rate of 15.3%, suggesting challenges in coping with saline intrusion, while Integrated Agriculture and Poultry and Duck and Fish farming exhibit adaptability rates of 0.0% and 7.9% respectively, indicating significant vulnerabilities to saline intrusion. Furthermore, CALOs like Vermicompost and Saline water fisheries demonstrate promising adaptability, with 48.3% and 25.0% respectively, suggesting their effectiveness in coping with saline intrusion and contributing to sustainable agricultural practices in the region.

Table 36: Percentage of respondent's perception of their CALO being able to cope with cyclones and storm surges. (Response in %, N=1011)

CALO	Yes	To some extent	No	Not applicable
Crab fattening	45.8	54.2	0.0	0.0
Carp fish polyculture	10.2	81.6	8.2	0.0
Sheep rearing	20.8	25.0	27.8	26.4
Pig rearing	25.0	75.0	0.0	0.0
Integrated Agriculture and Poultry	0.0	67.1	32.9	0.0
Duck and Fish farming	7.9	57.1	34.9	0.0
Integrated agriculture farming	8.2	74.2	15.5	2.1
Green Job (Bamboo-based Handicraft)	12.5	87.5	0.0	0.0
Duck rearing	4.2	56.3	35.4	4.2
Maize Cultivation	0.0	66.7	14.6	18.8
Integrated vegetable cultivation	9.5	31.7	20.6	38.1
Mung bean cultivation	0.0	91.7	8.3	0.0
Watermelon cultivation	0.0	4.2	0.0	95.8
Vermicompost	48.3	41.4	3.4	6.9
Saline water fisheries	12.5	83.3	4.2	0.0
Sheep and Duck rearing	2.0	83.7	14.3	0.0
Brackishwater Fish Polyculture	0.0	93.8	6.3	0.0
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	5.6	84.5	0.0	9.9
Sunflower cultivation	0.0	0.0	100.0	0.0
Native Poultry Rearing	8.3	75.0	16.7	0.0
Native Chicken Rearing	11.8	64.5	23.7	0.0
F-1 Calf Rearing	0.0	58.3	0.0	41.7
Total	9.4	62.5	18.4	9.7

The above table presents respondents' perceptions of the adaptability of various CALOs in the Young Meghna Estuarine Floodplain agro-ecological area, highlighting their effectiveness in mitigating climate-related risks and vulnerabilities specific to this region. This area is characterized by young alluvial lands around the Meghna estuary, facing challenges such as cyclones, storm surges, sea-level rise, salinity intrusion, and waterlogging. Around 32.9% Integrated agriculture and poultry, 34.9% Duck and Fish farmers, and 23.7% Native chicken farmers said their CALOs are not able to cyclone and storm surges.

Carp fish polyculture, Integrated Agriculture and Poultry, and Brackish water fish polyculture

exhibit varying degrees of adaptability, with 81.6%, 67.1% and 93.8% of the farmers respectively saying that their CALOs are to some extent able to cope with the cyclone and storm surges. Additionally, Stress Tolerant Vegetable cultivation shows high adaptability. indicating their potential to mitigate the impacts of storms and cyclones. These findings underscore the importance of promoting and implementing adaptive CALOs tailored to the specific climatic conditions and vulnerabilities in the Young Meghna Estuarine Floodplain.

Table 37: Percentage of respondent's perception of their CALO being able to cope with floods/flash floods. (Response in %, N=1011)

CALO	Yes	To some extent	No	Not applicable
Crab fattening	29.2	70.8	0.0	0.0
Carp fish polyculture	0.0	49.0	51.0	0.0
Sheep rearing	19.4	34.7	30.6	15.3
Pig rearing	29.2	70.8	0.0	0.0
Integrated Agriculture and Poultry	0.0	56.2	43.8	0.0
Duck and Fish farming	6.3	47.6	46.0	0.0
Integrated agriculture farming	10.3	68.0	21.6	0.0
Green Job (Bamboo-based Handicraft)	18.8	81.3	0.0	0.0
Duck rearing	4.2	47.9	43.8	4.2
Maize Cultivation	0.0	68.8	27.1	4.2
Integrated vegetable cultivation	7.9	34.9	19.0	38.1
Mung bean cultivation	0.0	20.8	79.2	0.0
Watermelon cultivation	0.0	0.0	0.0	100.0
Vermicompost	51.7	20.7	24.1	3.4
Saline water fisheries	8.3	87.5	4.2	0.0
Sheep and Duck rearing	0.0	73.5	26.5	0.0
Brackishwater Fish Polyculture	0.0	95.8	4.2	0.0
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	5.6	87.3	1.4	5.6
Sunflower cultivation	0.0	0.0	100.0	0.0
Native Poultry Rearing	0.0	91.7	8.3	0.0
Native Chicken Rearing	9.7	67.7	22.6	0.0
F-1 Calf Rearing	0.0	58.3	41.7	0.0
Total	8.1	58.0	27.2	6.7

The above table presents respondents' perceptions of the adaptability of various CALOs to cope with floods/flash floods, providing insights into the effectiveness of these CALOs in mitigating climate-related risks and vulnerabilities associated with these natural disasters. The table highlights significant variations in adaptability among different CALOs, reflecting their diverse responses to floods and flash floods. CALOs such as Vermicompost, Crab fattening, and pig rearing demonstrate notable adaptability, with percentages of 51.7%, 29.2%, and 29.2%, respectively. These findings suggest that these practices are well-suited to cope with floods and flash floods, potentially reducing vulnerability to such climatic events. Conversely, farmers of CALOs like Carp fish polyculture, Maize Cultivation, sheep rearing, Integrated Agriculture and poultry, show lower

adaptability rates, Duck and fish farming, Mung bean cultivation and sunflower cultivation with 51.0%, 27.1%, 30%, 43.8%, 46.0%, 79.2% and 100% respectively said their CALOs are not able to cope with floods/flash floods, indicating their vulnerability to floods and flash floods and the need for further support or alternative

strategies to improve their effectiveness in mitigating climate risks. Overall, the table underscores the importance of promoting and implementing adaptive CALOs tailored to specific climatic conditions and vulnerabilities associated with floods and flash floods. Practices like Vermicompost production, Crab fattening, and Saline water fisheries emerge as viable options for enhancing resilience to climate-related risks associated with floods and flash floods. However, CALOs with lower adaptability rates, such as Carp fish polyculture and Maize Cultivation, may require additional support or alternative strategies to improve their effectiveness in mitigating climate risks posed by floods and flash floods.

Table 38: Percentage of respondent's perception of their CALO showing resilience to increased pest and disease outbreaks likely due to climatic changes. (Response in %, N=1011)

CALO	Yes	To some extent	No	Not applicable
Crab fattening	4.2	95.8	0.0	0.0
Carp fish polyculture	0.0	59.2	10.2	30.6
Sheep rearing	16.7	56.9	8.3	18.1
Pig rearing	29.2	50.0	20.8	0.0
Integrated Agriculture and Poultry	0.0	79.5	20.5	0.0
Duck and Fish farming	4.8	55.6	38.1	1.6
Integrated agriculture farming	10.3	85.6	4.1	0.0
Green Job (Bamboo-based Handicraft)	12.5	75.0	0.0	12.5
Duck rearing	8.3	81.3	6.3	4.2
Maize Cultivation	2.1	77.1	20.8	0.0
Integrated vegetable cultivation	9.5	46.0	6.3	38.1
Mung bean cultivation	8.3	91.7	0.0	0.0
Watermelon cultivation	0.0	0.0	0.0	100.0
Vermicompost	44.8	13.8	3.4	37.9
Saline water fisheries	0.0	70.8	4.2	25.0
Sheep and Duck rearing	0.0	95.9	4.1	0.0
Brackishwater Fish Polyculture	0.0	79.2	2.1	18.8
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	12.7	85.9	1.4	0.0
Sunflower cultivation	4.2	45.8	50.0	0.0
Native Poultry Rearing	12.5	75.0	12.5	0.0
Native Chicken Rearing	14.0	69.9	16.1	0.0
F-1 Calf Rearing	0.0	62.5	37.5	0.0
Total	8.6	68.8	12.0	10.6

The above table provides valuable insights into the resilience of various CALOs to increased pest and disease outbreaks likely due to climatic changes. It highlights the effectiveness of these CALOs in mitigating climate-related risks associated with such outbreaks, shedding light on their adaptability to changing climatic conditions and vulnerabilities. Several CALOs demonstrate notable resilience to increased pest and disease outbreaks. For example, Vermicompost production exhibits a high resilience rate of 44.8%, indicating its effectiveness in coping with pest and disease challenges. Similarly, pig rearing and Sheep rearing show moderate resilience rates of 29.2% and 16.7%, respectively, suggesting their ability to withstand pest and disease outbreaks. However, some CALOs exhibit lower resilience to increased pest and disease outbreaks. For instance, farmers of Carp fish polyculture (51%), Integrated agriculture and poultry (79.5%), Crab fattening (95.8%), Integrated agriculture and poultry (79.5%), Duck rearing (81.3%), maize cultivation (77.1%), Mung bean cultivation (91.75%), sheep and duck rearing (95.9%), Saline water fisheries (70.8%), Brackishwater fish polyculture (79.2%), stress tolerant vegetables (86.9%), Native poultry rearing (75%), Native chicken rearing (69.9%), F- calf rearing (62.5%) said their CALOs are to some extent shoed resilience to increased pest and diseases outbreaks. While these practices may provide some level of resilience against pest and disease challenges, there is room for improvement to enhance their effectiveness in coping with such climatic impacts. Overall, 12% of the farmers said their CALOs are not resilient to the increased pest and disease outbreak. Finally, the table underscores the importance of promoting and implementing adaptive CALOs tailored to specific climatic conditions and vulnerabilities associated with increased pest and disease outbreaks. Practices like Vermicompost production, Pig rearing, and Sheep rearing emerge as viable options for enhancing resilience to climate-related risks associated with such outbreaks. However, CALOs with lower resilience rates, such as Carp fish polyculture and Maize Cultivation, may require additional support or alternative strategies to improve their effectiveness in mitigating climate risks posed by increased pest and disease outbreaks.

Table 39: Percentage of respondent's perception of their CALO being flexible enough to adapt to shifts in growing or harvesting seasons. (Response in %, N=1011)

CALO	Yes	To some extent	No	Not applicable
Crab fattening	4.2	45.8	0.0	50.0
Carp fish polyculture	2.0	36.7	6.1	55.1
Sheep rearing	19.4	52.8	1.4	26.4
Pig rearing	33.3	20.8	0.0	45.8
Integrated Agriculture and Poultry	24.7	58.9	16.4	0.0
Duck and Fish farming	7.9	49.2	27.0	15.9
Integrated agriculture farming	21.6	77.3	1.0	0.0
Green Job (Bamboo-based Handicraft)	6.3	68.8	18.8	6.3
Duck rearing	20.8	52.1	2.1	25.0
Maize Cultivation	2.1	79.2	18.8	0.0
Integrated vegetable cultivation	38.1	49.2	1.6	11.1
Mung bean cultivation	33.3	66.7	0.0	0.0
Watermelon cultivation	62.5	0.0	0.0	37.5
Vermicompost	62.1	34.5	0.0	3.4
Saline water fisheries	0.0	70.8	4.2	25.0
Sheep and Duck rearing	0.0	93.9	0.0	6.1
Brackishwater Fish Polyculture	2.1	66.7	10.4	20.8
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	21.1	78.9	0.0	0.0
Sunflower cultivation	4.2	45.8	50.0	0.0
Native Poultry Rearing	0.0	54.2	29.2	16.7
Native Chicken Rearing	9.7	73.1	17.2	0.0
F-1 Calf Rearing	4.2	87.5	8.3	0.0
Total	17.0	60.9	9.0	13.1

The above table presents respondents' perceptions of the flexibility of various CALOs to adapt to shifts in growing or harvesting seasons. It offers valuable insights into the effectiveness of these CALOs in mitigating climate-related risks associated with changes in agricultural calendars. Watermelon cultivation and Vermicompost production emerge as highly flexible CALOs, with adaptability rates of 62.5% and 62.1%, respectively. These practices demonstrate a strong capacity to adjust to shifts in growing or harvesting seasons, potentially reducing vulnerability to disruptions in agricultural activities caused by changes in seasonal patterns. Integrated Agriculture Farming and Mung bean cultivation also show notable flexibility, with adaptability rates of 21.6% and 33.3%, respectively. These CALOs exhibit the ability to adapt to changes in agricultural calendars, contributing to resilience against climate-related risks associated with shifts in growing or harvesting seasons. On the other hand, farmers of CALOs such as Crab fattening (45.8%), Carp fish polyculture (36.7%), Sheep rearing(52.8%), integrated agriculture and poultry (58.9%), Dusk and Fish farming (49.2%), Integrated agricultural farming (77.3%), Duck rearing (52.1%), Maize cultivation (79.2%), Mung bean cultivation (66.75), Saline water fisheries (70.8%), Sheep and duck rearing (93.3%), Stress tolerant vegetables (78.9%), Native poultry rearing (54.2%), Native chicken rearing (73.1%) and F-1 calf rearing (87.5%) said their CALOs are to some extent able to adapt to the shift in growing or harvest seasons. These practices may face challenges in adjusting to shifts in growing or harvesting seasons, potentially increasing vulnerability to

disruptions in agricultural activities. Overall, the table underscores the importance of promoting and implementing flexible CALOs tailored to specific climatic conditions and vulnerabilities associated with changes in agricultural calendars. Practices like Watermelon cultivation, Vermicompost production, and Integrated Agriculture Farming emerge as viable options for enhancing resilience to climate-related risks associated with shifts in growing or harvesting seasons. However, CALOs with lower flexibility rates, such as Crab fattening and Carp fish polyculture and sunflower cultivation may require further support or alternative strategies to improve their effectiveness in mitigating climate risks posed by changes in agricultural calendars.

Table 40: Percentage of respondent's perception of how well their CALO perform in the local weather. (Response in %, N=1011)

CALO	Very well	Well	Neutral	Poorly	Very poorly
Crab fattening	4.2	95.8	0.0	0.0	0.0
Carp fish polyculture	0.0	42.9	30.6	26.5	0.0
Sheep rearing	2.8	90.3	6.9	0.0	0.0
Pig rearing	20.8	79.2	0.0	0.0	0.0
Integrated Agriculture and Poultry	0.0	53.4	32.9	12.3	1.4
Duck and Fish farming	7.9	57.1	4.8	20.6	9.5
Integrated agriculture farming	7.2	60.8	29.9	1.0	1.0
Green Job (Bamboo-based Handicraft)	0.0	93.8	6.3	0.0	0.0
Duck rearing	0.0	79.2	18.8	2.1	0.0
Maize Cultivation	0.0	77.1	18.8	4.2	0.0
Integrated vegetable cultivation	14.3	65.1	14.3	1.6	4.8
Mung bean cultivation	8.3	87.5	4.2	0.0	0.0
Watermelon cultivation	0.0	66.7	33.3	0.0	0.0
Vermicompost	27.6	51.7	20.7	0.0	0.0
Saline water fisheries	4.2	41.7	54.2	0.0	0.0
Sheep and Duck rearing	0.0	38.8	61.2	0.0	0.0
Brackishwater Fish Polyculture	0.0	70.8	25.0	4.2	0.0
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	5.6	49.3	43.7	0.0	1.4
Sunflower cultivation	0.0	20.8	33.3	45.8	0.0
Native Poultry Rearing	4.2	37.5	54.2	4.2	0.0
Native Chicken Rearing	9.7	52.7	21.5	14.0	2.2
F-1 Calf Rearing	0.0	83.3	12.5	4.2	0.0
Total	5.3	61.9	24.6	6.7	1.4

The above table provides insights into respondents' perceptions of how well their Community-Based Adaptation Livelihood Options (CALOs) perform in the local weather conditions. This perception sheds light on the effectiveness of these CALOs in mitigating climate-related risks and vulnerabilities, particularly in response to local weather variations. Farmers of CALOs such as Watermelon cultivation (66.7%), Crab fattening (95.8%), Sheep rearing (90.3%), Pig rearing (79.2%), Integrated agriculture farming (60.8%), green jobs (93.8%), Duck rearing (79.2%), Maize cultivation (77.1%), Integrated vegetable cultivation (65.1%), Mung bean cultivation (87.5%), Brakishwater fish polyculture (70.8%),

F-1 calf rearing (83.3%) said their CALOs are performing well in their local weather. This indicates that these practices are highly suitable and effective in adapting to local weather patterns, potentially reducing vulnerability to climate-related risks associated with weather variability. These CALOs demonstrate a considerable capacity to adapt to local weather variations, contributing to resilience against climate-related risks. However, CALOs like Carp fish polyculture and Sunflower cultivation receive mixed perceptions, with some respondents rating them as performing well while others rate them poorly (26.5% and 45.8% respectively) in local weather conditions. This variability suggests that these practices may have strengths and weaknesses in adapting to specific local weather patterns, requiring further assessment and potential adjustments to improve their effectiveness in mitigating climate risks. Overall, the table highlights the importance of promoting and implementing CALOs that perform well in local weather conditions to enhance resilience to climate-related risks. Practices like Watermelon cultivation, Vermicompost production, Integrated Agriculture and Poultry, and Integrated agriculture farming emerge as viable options for enhancing resilience to climate-related risks associated with changes in local weather conditions. However, CALOs with mixed perceptions, such as Carp fish polyculture and Sunflower cultivation, may require targeted interventions to address their weaknesses and capitalize on their strengths in adapting to local weather variations.

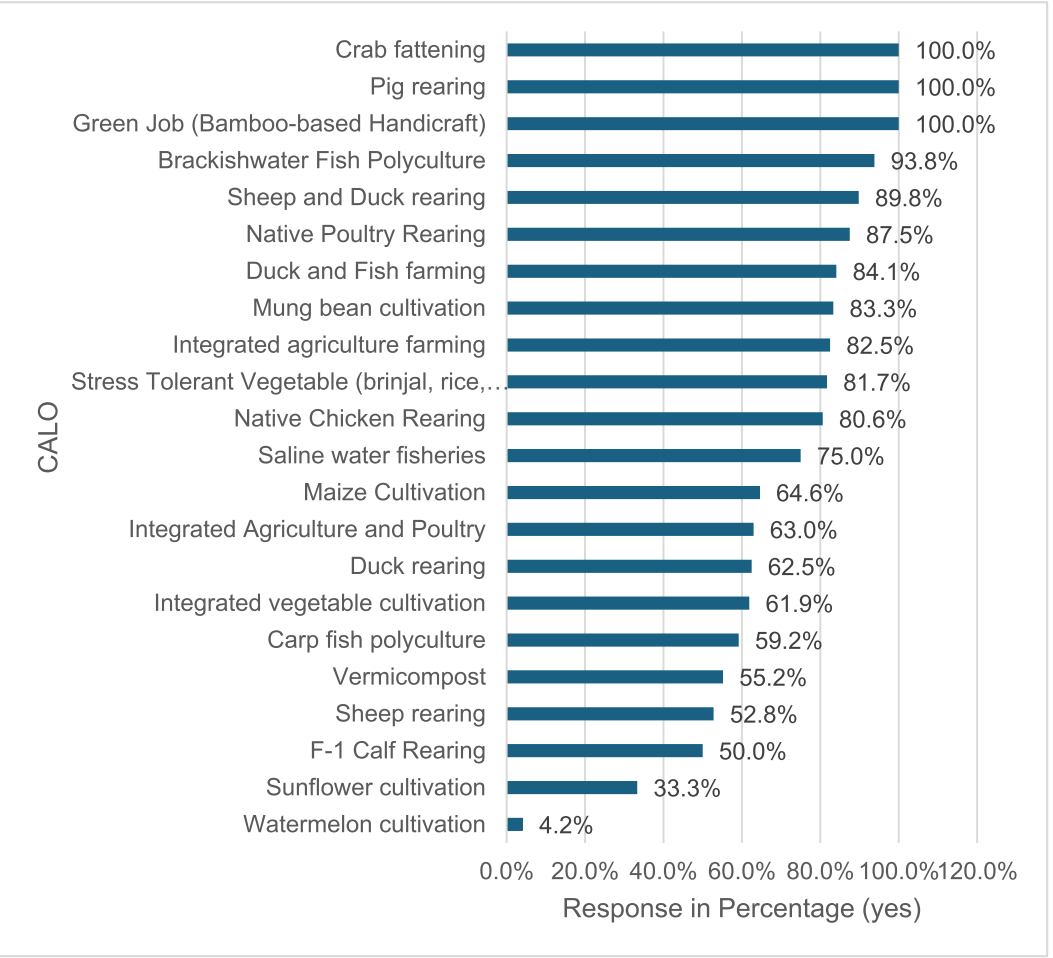

Figure 32: Percentage of respondent's opinion on the CALO they are practicing if that can be effectively implemented in other geographical areas with different climatic conditions. (Response in %, N=1011)

The above figure presents respondents' opinions on whether the CALOs they are practicing can be effectively implemented in other geographical areas with different climatic conditions. This perception sheds light on the adaptability and potential scalability of these CALOs to diverse environmental contexts, thus addressing climate-related risks and vulnerabilities.

CALOs such as Crab fattening, Pig rearing, and Green Job (Bamboo-based Handicraft) receive overwhelmingly positive responses, with 100% of respondents affirming their potential effectiveness in other geographical areas. This indicates a high level of confidence in the adaptability and scalability of these practices across diverse climatic conditions, suggesting their efficacy in reducing climate-related risks and vulnerabilities. Duck and Fish farming, Integrated agriculture farming, and Mung bean cultivation also receive strong support, with 84.1%, 82.5%, and 83.3% of respondents respectively, endorsing their potential effectiveness in other geographical areas. These CALOs demonstrate promising adaptability to different climatic conditions, reflecting their capacity to mitigate climate risks and vulnerabilities in varied environmental contexts. However, Watermelon cultivation receives a notably low percentage of positive responses, with only 4.2% of respondents considering it effectively implementable in other geographical areas. This suggests limitations in the adaptability of Watermelon cultivation to diverse climatic conditions, potentially reducing its effectiveness in mitigating climate-related risks outside of its current geographical context. CALOs like Sunflower cultivation and F-1 Calf Rearing also receive mixed responses, with a significant percentage of respondents expressing uncertainty about their effectiveness in other geographical areas. This variability in perceptions underscores the importance of further assessment and adaptation to ensure the scalability and efficacy of these practices in mitigating climate risks across diverse environmental contexts.

Overall, the table highlights the importance of promoting and implementing CALOs with high adaptability and scalability to different climatic conditions. Practices like Crab fattening, Pig rearing, Duck and Fish farming, and Integrated agriculture farming emerge as viable options for enhancing resilience to climate-related risks associated with changes in climatic conditions. However, CALOs with lower perceived effectiveness in other geographical areas may require additional research and adaptation to maximize their potential impact in mitigating climate risks and vulnerabilities on a broader scale.

Table 41: Percentage of respondent's perception on how much their vulnerability to climate-related risks (like floods, droughts, storms) reduced since participating in the CALO. (Response in %, N=1011)

CALO	Not reduced at all	Slightly reduced	Moderately reduced	Significantly reduced	Greatly reduced
Crab fattening	0.00	8.30	58.30	29.20	4.20
Carp fish polyculture	0.00	49.00	24.50	26.50	0.00
Sheep rearing	0.00	16.70	41.70	40.30	1.40
Pig rearing	0.00	29.20	25.00	45.80	0.00
Integrated Agriculture and Poultry	15.10	72.60	12.30	0.00	0.00
Duck and Fish farming	25.40	42.90	11.10	19.00	1.60
Integrated agriculture farming	0.00	37.10	23.70	39.20	0.00
Green Job (Bamboo-based Handicraft)	0.00	37.50	50.00	12.50	0.00
Duck rearing	0.00	41.70	29.20	29.20	0.00
Maize Cultivation	0.00	25.00	54.20	20.80	0.00
Integrated vegetable cultivation	0.00	52.40	25.40	22.20	0.00
Mung bean cultivation	0.00	33.30	45.80	20.80	0.00
Watermelon cultivation	0.00	12.50	66.70	20.80	0.00
Vermicompost	0.00	37.90	31.00	31.00	0.00
Saline water fisheries	0.00	70.80	29.20	0.00	0.00
Sheep and Duck rearing	2.00	65.30	32.70	0.00	0.00
Brackishwater Fish Polyculture	2.10	18.80	45.80	33.30	0.00
Stress Tolerant Vegetable (brinjal, rice, red-amaranth, cucumber .)	0.00	71.80	15.50	11.30	1.40
Sunflower cultivation	0.00	70.80	29.20	0.00	0.00
Native Poultry Rearing	8.30	37.50	25.00	29.20	0.00
Native Chicken Rearing	11.80	36.60	24.70	26.90	0.00
F-1 Calf Rearing	0.00	0.00	50.00	50.00	0.00
Total	4.20	41.80	30.20	23.40	0.40

Above table illustrates respondents' perceptions regarding the extent to which their vulnerability to climate-related risks has diminished following their participation in various Community-Based Adaptation Livelihood Options (CALOs). Notably, CALOs like crab fattening, sheep rearing, pig rearing, duck and fish farming, and integrated agriculture farming demonstrated significantly reduced vulnerability, with percentages ranging from 29.2% to 40.3%. Additionally, carp fish polyculture, maize cultivation, and integrated vegetable cultivation showed slightly reduced vulnerability rates, ranging from 30% to 50%. These findings highlight the effectiveness of specific CALOs in mitigating climate-related vulnerabilities, suggesting their potential as strategies for enhancing community resilience to climate change-induced risks such as floods, droughts, and storms. Further research and support should be directed toward understanding the mechanisms underlying the success of these CALOs and replicating them in vulnerable communities to bolster climate resilience comprehensively.

In conclusion, it becomes evident that certain CALOs exhibit high adaptability to changes in climatic conditions, effectively mitigating risks associated with fluctuations in rainfall intensity and frequency. Practices such as watermelon cultivation, vermicompost production, integrated agriculture farming,

and integrated livestock rearing emerge as particularly viable options for enhancing resilience to climate-related challenges. However, CALOs with lower adaptability rates may require further support or alternative strategies to improve their effectiveness in mitigating climate risks. Overall, promoting and implementing adaptive CALOs tailored to specific climatic conditions is crucial for building resilience and reducing vulnerabilities in communities facing climate change impacts.

4.2.1 Comprehensive discussion on adaptability of CALOs

The table below presents an assessment of the adaptability of various Climate Adaptive Livelihood Options (CALOs) based on direct feedback from respondents who are currently practicing these options. The adaptability score is derived from responses to ten questions that evaluated the resilience of each CALO to a range of climatic stressors including extreme temperatures, drought, changes in rainfall patterns, salinity intrusion, cyclones, floods, pest outbreaks, and shifts in growing or harvesting seasons. The scoring system assigned "Yes," "Somewhat," and "Not Applicable" a value of 1, indicating adaptability, while "No" was scored as 0, indicating non-adaptability. The total score for each CALO was converted into a percentage and averaged to determine the overall adaptability percentage.

Table 42: *Comprehensive adaptability scoring of all CALOs*

CALO Name	Adaptability
Watermelon cultivation	100.00
Crab fattening	99.58
Stress Tolerant Vegetable (brinjal, rice,red-amaranth, cucumber .)	98.87
Green Job (Bamboo-based Handicraft)	98.13
Saline water fisheries	97.92
Vermicompost	96.90
Sheep and Duck rearing	93.27
Brackishwater Fish Polyculture	92.71
Integrated agriculture farming	91.65
F-1 Calf Rearing	91.25
Integrated vegetable cultivation	90.95
Duck rearing	86.67
Mung bean cultivation	86.67
Native Poultry Rearing	86.67
Maize Cultivation	85.42
Sheep rearing	84.88
Native Chicken Rearing	83.01
Pig rearing	79.45
Carp fish polyculture	76.12
Integrated Agriculture and Poultry	73.42
Duck and Fish farming	69.84
Sunflower cultivation	14.17

High Adaptability CALOs

Watermelon cultivation emerged as the most adaptable CALO with a perfect score of 100%. This indicates that all respondents practicing watermelon cultivation found it resilient to the climatic stressors in their areas. Watermelon cultivation's high adaptability could be attributed to its resilience to varying rainfall patterns and temperature extremes, as well as its suitability to the local soil and water conditions.

Crab fattening follows closely with a score of 99.58%. The high adaptability score for crab fattening suggests its strong resilience to salinity intrusion and cyclonic events, which are common in coastal regions. Crab fattening likely benefits from its ability to thrive in both brackish and saline water conditions.

Stress Tolerant Vegetables (such as brinjal, rice, red-amaranth, cucumber) scored 98.87%, demonstrating their strong adaptability to climatic variability. These crops are likely bred for resilience, making them suitable for areas experiencing shifts in growing seasons and pest outbreaks.

Green Jobs related to bamboo-based handicrafts scored 98.13%, indicating the sustainable and adaptable nature of bamboo as a raw material. Bamboo's rapid growth and resilience to various climatic conditions make it an ideal resource for handicrafts.

Saline water fisheries scored 97.92%, reflecting their robustness against salinity intrusion and other coastal climatic challenges. Fish species used in these practices are likely selected for their tolerance to higher salinity levels.

Vermicomposting (96.90%) and **Sheep and Duck rearing** (93.27%) also show high adaptability, indicating that these practices are resilient and can be sustained under diverse climatic conditions.

Moderate Adaptability CALOs

Several CALOs exhibit moderate adaptability, with scores ranging between 70% and 90%. **Brackishwater Fish Polyculture** (92.71%) and **Integrated agriculture farming** (91.65%) are notable examples, demonstrating significant resilience but potentially facing specific challenges that prevent higher scores. **Integrated vegetable cultivation** (90.95%) and **Duck rearing** (86.67%) also fall into this category, suggesting they are generally adaptable but may require specific management practices to cope with certain climatic stressors.

Native Poultry Rearing (86.67%) and **Maize Cultivation** (85.42%) show moderate resilience, indicating these options can be viable but may not be universally adaptable without targeted interventions.

Low Adaptability CALOs

Some CALOs exhibit lower adaptability, suggesting they may be more vulnerable to climatic stressors. **Pig rearing** (79.45%), **Carp fish polyculture** (76.12%), and **Integrated Agriculture and Poultry** (73.42%) fall into this category, highlighting the need for improved practices or alternative options in areas facing severe climatic challenges.

Duck and Fish farming scored 69.84%, indicating significant vulnerabilities that may limit its sustainability under certain conditions.

The lowest score is observed for **Sunflower cultivation** (14.17%), indicating that only around 14% of respondents found this CALO to be adaptable to climate-related risks. This low adaptability suggests that sunflower cultivation faces substantial challenges in coping with climatic stressors, such as extreme temperatures and changes in rainfall patterns.

4.3 Stakeholder Involvement Analysis Involvement analysis

4.3.1 Stakeholder analysis (from national to local level)

In any project or initiative, understanding the diverse range of stakeholders involved is paramount for its success. A stakeholder analysis serves as a strategic tool to systematically identify, analyze, and prioritize the individuals, groups, or organizations that have a vested interest in the outcomes or impacts of a particular endeavor. This chapter delves into the intricacies of stakeholder analysis, offering insights into its significance for ultimately achieving project objectives with broader societal relevance.

National level

LGIs, communities, marginalized groups, and those most vulnerable are confronted with numerous obstacles when addressing climate action. The Local Government Initiative on Climate Change (LoGIC) project is dedicated to addressing local climate change adaptation (CCA) challenges within seven climate-vulnerable districts of Bangladesh. LoGIC aims to bolster the capabilities of LGIs, vulnerable communities, and civil society organizations (CSOs) to engage in inclusive and effective local-level planning and financing. As a Nationally Implemented Project (NIM), overseen by the Local Government Division (LGD) of the Ministry of Local Government, Rural Development and Cooperatives (MoLGRD&C), LoGIC operates as a collaborative effort between the United Nations Development Program (UNDP), the United Nations Capital Development Fund (UNCDF), with financial backing from the European Union (EU) and the Embassy of Sweden. The project, launched in 2016 with a budget of USD 20 million over four years, faced delays in securing approval from the Government of Bangladesh (GoB) and in defining eligible interventions for PBCRG and CRF funding, resulting in implementation commencing only in 2018. LoGIC has evolved into a multi-donor initiative, expanding its reach to include 72 Unions across 19 Upazilas in seven districts, with additional support from international partners such as UNDP, UNCDF, and the Embassy of Denmark, thereby reaffirming its commitment to bolstering climate resilience nationwide.

Local Level

LoGIC was structured to assist approximately 500,000 of Bangladesh's most vulnerable households dispersed across different districts. The initiative engaged local government bodies, including 29 Upazila Parishads, and civil society organizations, empowering them to devise and fund climate change adaptation strategies tailored to vulnerable regions. Notably, the implementation of the Climate Resilience Fund (CRF) yielded significant impacts, directly benefiting 1.97 million individuals and 437,923 households within the project's operational zones. The effectiveness of LoGIC is evident across all 72 Union Parishads. The project prioritized enhancing the capacities of local government institutions, facilitating training for 125 officials from diverse government departments and 72 Union Parishads.

LoGIC introduces innovative measures like establishing Climate-Resilient Cooperatives, aiming to bolster climate-vulnerable households by fostering green businesses and facilitating access to financial services via formal banking channels and capital markets. With 247 ward-level cooperatives now operational, each possessing a legal framework, this initiative empowers 35,000 beneficiaries of the Community Resilience Fund (CRF) to elevate their investments in climate-adaptive practices. Moreover, LoGIC's vision extends to the creation of a Climate Change Adaptation Innovation Centre (CCAIC), poised to catalyze innovation in climate adaptation efforts. This comprehensive approach has already aided over 213,000 individuals susceptible to climate change impacts, with a particular focus on supporting 35,000 vulnerable beneficiaries, 99% of whom are women. Concurrently, collaborative efforts with stakeholders such as Upazila Line department officials, the Helvetas Foundation, and key partners like UNDP and UNCDF Country

Office, alongside consultations with governing board members, donors, project staff, and consultants, underscore the project's commitment to inclusive and informed decision-making.

Within Output 1, the project has facilitated various activities encompassing awareness-raising, capacity development, planning, financing, guideline and manual development, and beneficiary identification for the CRF. It has actively supported CRAs and the formulation of RRAPs and HHRRAPs at both Union Parishad (UP) and household levels. Notably, the project has provided training to a total of 17,000 CRF beneficiaries and 234 UP members and chairpersons. At the household level, LoGIC has prioritized enhancing the livelihood diversification skills of CRF beneficiaries, implementing a comprehensive training calendar and plan across all 72 UPs. The development of 16 training manuals for CALO training represents a significant endeavor. Collaboration between line department officials, extension officers, Helvetas, and LoGIC staff during CALO training sessions showcases effective local-level convergence. Noteworthy is the robust beneficiary selection process for the CRF, characterized by high transparency and the inclusion of a complaint redressal mechanism to minimize errors of inclusion/exclusion and mitigate political influence or nepotism. Direct transfer of CRF funds to beneficiary bank accounts enhances transparency and reduces leakage risks, although administering the same selection process independently at the UP level may pose challenges.

Governance Arrangements

LoGIC collaborates closely with the Local Government Division (LGD), fostering synergies with line departments at the Union Parishad (UP) level for livelihoods training. However, this cooperation lacks formal representation at the national level. Additionally, LoGIC's interaction with the Ministry of Environment, Forests, and Climate Change, responsible for leading climate change adaptation efforts, remains minimal. A steering committee, led by the Senior Secretary/Secretary of LGD, is overseeing the project, comprising representatives from relevant ministries and stakeholders such as the Ministry of CHT Affairs, Ministry of Environment and Forest, Ministry of Disaster Management and Relief, Ministry of Planning, and Ministry of Finance. Additionally, representatives from the Swedish International Cooperation Agency and Denmark. The Project Coordinator will provide secretarial support to the Board, which will be chaired by the NPD, a senior official of the Ministry/LGD, ensuring overall direction, strategic guidance, and timely delivery of project outputs. Alternatively, LGD may nominate a senior official as Executive Chair to uphold project ownership. UNDP and UNCDF will offer guidance on technical feasibility, compliance, and resource utilization. While the project's governance and management structure align with its design, there are notable efficiency gaps. Although LoGIC operates as a 'Nationally Implemented Project' overseen by a National Project Director and a Deputy Project Director, both from the government, their effectiveness in championing LoGIC varies with personnel changes. The current governance framework aims for close integration of project processes within government structures, particularly the LGD and other relevant ministries. Given the centralized control over Bangladesh's local government system, LoGIC's firm integration within the Local Government Division of MoLGRD&C, alongside active engagement with national, district, and local line departments, is imperative. Engagement with local line department officials, notably in agriculture, livestock, and fisheries, has been observed for leading CALO trainings and providing subsequent guidance. Stakeholders suggest deeper connections with DDLG entities to enhance their understanding of LoGIC's objectives, advocating for formalized engagement and a structured framework to consolidate support for specific livelihood activities and joint field missions.

Management Arrangements

UNDP and UNCDF are responsible for recruiting a Project Coordinator (PC), who is primarily accountable to the NPD and oversees day-to-day operations and management of a team of professionals and technical staff recruited by UNDP and UNCDF to execute the project. Employing Matrix management, the PC ensures project quality, standards, fiduciary risks, progress reporting, result reporting, and relationship management with both UNDP and UNCDF. Additionally, the head of R&IG at UNDP, Climate Change specialist, and Program Specialist at UNCDF provide technical guidance and support to the PC and the project as part of their project management roles (40%), ensuring quality assurance for effective and accountable project management. Working under the guidance of the NPD, the PC implements the project with the support of four purposive teams. UNDP and UNCDF assume a Project Assurance Role. This includes management of funds, project quality assurance through technical support to the project team, fiduciary risk management, timely delivery of financial and project reports to development partners, and management of project personnel. Two designated officers from UNDP and UNCDF dedicate 40% of their time to the project for development partner relationship and reporting, quality monitoring, fiduciary risk management, and relationship management with various government agencies to facilitate smooth project implementation. Managing funds from development partners (SIDA and Embassy of Denmark), UNDP and UNCDF disburse quarterly advance payments against agreed work plans to a project account managed by the PMU. LGD establishes specific "letter of agreement" with relevant agencies for project implementation. LoGIC must ensure that its project team comprises individuals possessing the requisite expertise and influence to effectively manage the policy agenda. This necessitates close collaboration with senior officials from various ministries, including MoLGRD&C, Finance, Environment, and Planning, as well as IFIs and donors. Such partnerships are crucial for bolstering the climate narrative, navigating political pressures, and optimizing the scope of interventions.

Field level Execution

At the district and sub-district level, officials from the LGD, LGI, and HDCs currently supervise the implementation of the project, supported by project staff. The implementation is being carried out in close collaboration with the local government and district and sub-district level development committees. A coordination mechanism led by UNO currently oversees the project implementation at UP/UPz level. This coordination mechanism facilitates avoiding duplication of infrastructural work, overseeing the quality of the work at UP/UPz and community levels, and providing guidance for better implementation of the PBCRG and CRF schemes.

At the district level, LoGIC teams work in tandem with Union Parishad (UP) and select line department officials to execute project activities. They oversee beneficiary selection for the CRF, coordinate CALO trainings, and facilitate discussions on potential projects to be undertaken using PBCRG funds. This collaborative approach, blending 'top-down' and 'bottom-up' strategies, ensures project alignment with local needs and priorities. While engagement with local line department officials has yielded positive outcomes, national-level involvement remains somewhat limited. LoGIC also recruited engineers at the Upazila level, it is expected that the technical parameters of PBCRG schemes will improve with this additional input. The national-level engagement has been somewhat limited. LoGIC operates within a project framework, with project staff primarily responsible for implementation, while elected UP and Local Government Institution (LGI) representatives focus on approving PBCRG schemes and occasionally monitoring their progress. Nonetheless, instances of district administration support, such as facilitating market access through government schemes like 'Suhasini,' underscore the potential for broader collaboration. Progress against the results framework is reported annually to the LoCAL global

Board. The progress against the results framework is reported annually to the LoCAL global Board, together with the other participating countries, and attended by the GoB.

Partnership

Collaboration with BRAC has been established to enhance the capacity of Climate Resilient Livelihood Fund (CRF) beneficiaries and to connect them with private sector opportunities. BRAC has developed 17 training modules focused on Climate Adaptive Livelihoods (CALO) to support scalable business ventures. This partnership aims to provide training to 53,000 CRF beneficiaries on economically viable adaptive livelihood options. Additionally, a partnership with Population Crisis Control and Mass Education Committee (PCC & MEC) has been formed to bolster market linkage and financial inclusion for CRF beneficiaries, particularly women. This collaboration seeks to assist 18,000 beneficiaries in opening individual and group bank accounts and to strengthen the financial understanding of 35,000 beneficiaries. Moreover, partnerships with Bangladesh University of Engineering Technology (BUET) and Center for Natural Resources Studies (CNRS) have been established to implement nature-based solutions under the Participatory Budgeting and Climate Resilience Governance (PBCRG) schemes. These partnerships involve transferring technology for soil erosion reduction using vetiver grass and mangrove plantation initiatives led by BUET and CNRS respectively. These collaborations are expected to play a pivotal role in the successful implementation of nature-based solutions.

This new stakeholder partnership is elevating Climate Adaptive Livelihoods (CALO) by significantly enhancing the capacity and opportunities available to Climate Resilient Livelihood Fund (CRF) beneficiaries. Through collaborations with BRAC, Population Crisis Control and Mass Education Committee (PCC & MEC), Bangladesh University of Engineering Technology (BUET), and Center for Natural Resources Studies (CNRS), various aspects crucial to the success of CALO are being addressed. BRAC's training modules on CALO and its focus on scalable business opportunities provide beneficiaries with valuable skills and access to markets. The partnership with PCC & MEC aims to improve financial inclusion and market linkage, particularly for vulnerable groups like women. Additionally, collaborations with BUET and CNRS introduce nature-based solutions to address climate-induced hazards, such as soil erosion and flooding, further enhancing the resilience of CALO initiatives. Overall, these partnerships contribute to a comprehensive approach towards elevating CALO by addressing capacity building, financial inclusion, market access, and nature-based solutions, ensuring the sustainability and effectiveness of livelihood projects in the face of climate change.

4.3.2 Engagement Matrix

The Logic project categorizes stakeholders based on their roles in the overall project framework as follows:

Strategic: Strategic stakeholders, including government bodies and policymakers such as the LGD, are responsible for formulating rules, regulations, and budget allocation decisions at a systemic level, influencing climate resilience initiatives on a macroeconomic scale.

Tactical: The tactical group of stakeholders, which may involve UNDP and UNCDF, focuses on designing and planning technical solutions, innovations, and processes to enhance climate resilience in collaboration with local government entities.

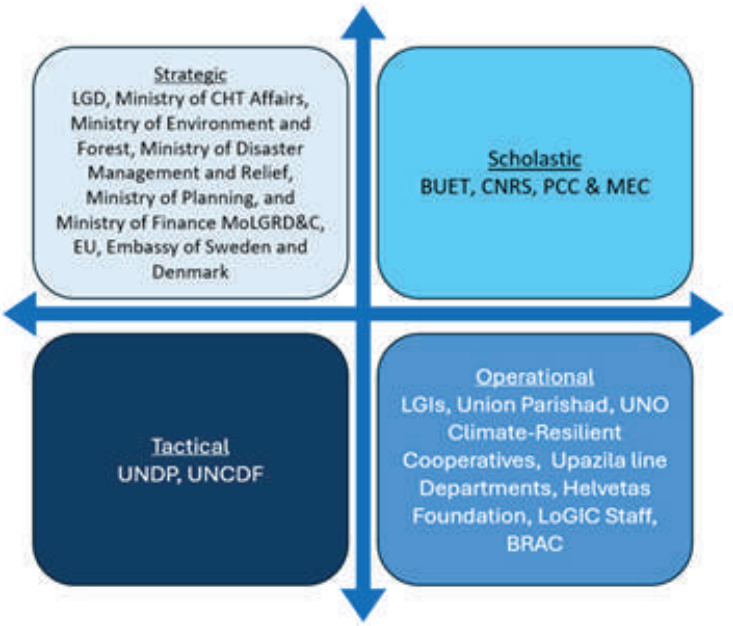

Figure 33: *Stakeholder engagement matrix*

Operational: Operational stakeholders encompass individuals or organizations directly engaged in implementing policies and programs, such as LGI, HDCs, and contracted NGOs/service providers selected through competitive procurement mechanisms or UN/DP's pre-qualified entities. These actors work on specific projects to execute climate resilience initiatives at district and sub-district levels.

Scholastic: The scholastic stakeholder group, represented by academic institutions and knowledge dissemination platforms, plays a crucial role in disseminating information, producing and reproducing knowledge, and creating audio-visual materials to influence the broader discourse on urban resilience.

It was evident from the analysis that the overall stakeholder's involvement has made the project successful throughout its intervention areas and for its beneficiary. A strong governing body and well-articulated management and field officials ensured its proper implementation. But there are some areas where other prominent stakeholders can bring more contextual experience for the beneficiaries. Academicians from well reputed universities and consultants from government and non-government training institutions can contextualize the training module or CALO farmers and Ups. This link is missing in the overall engagement.

Here's a stakeholder analysis based on interests, influence, and concerns of various stakeholders involved.

Table 43: *Stakeholder Influence matrix*

Stakeholders	Interest	Influence	Concerns
Local Government Institutions (LGIs):	Interested in receiving support for climate change adaptation efforts in their respective districts.	They have significant influence in the implementation of climate adaptation plans at the local level.	Lack of sufficient devolved budgets and political incentives for addressing climate change.
Donors (European Union, Embassy of Sweden, Danish International Development Agency):	Investing in climate change adaptation and resilience-building initiatives.	Providing financial support and strategic guidance.	Ensuring efficient use of funds and long-term sustainability of projects.
Line Department Officials and Extension Officers:	Supporting climate adaptation efforts through training and capacity building.	Delivering training programs and providing technical expertise.	Coordination with other stakeholders, timing of training, and aligning activities with local needs and seasonality.
Government of Bangladesh (GoB):	Interested in addressing climate change impacts and reducing vulnerabilities in vulnerable areas.	Holds regulatory and policy-making authority.	Weak policy frameworks and capacities for planning, delays in project approval, and strategic gaps in governance and management.
Civil Society Organizations (CSOs):	Interested in promoting inclusive and effective local-level planning and financing for climate change adaptation	They play a role in advocacy and implementation of adaptation projects.	Dependency on project-based funding and the need for robust policy frameworks for institutionalization.
United Nations Development Program (UNDP) and United Nations Capital Development Fund (UNCDF):	Supporting local climate change adaptation initiatives in Bangladesh.	Providing funding and technical support for project implementation.	Ensuring project sustainability beyond the project's lifetime and maximizing impact beyond implementation.
Communities and Vulnerable Households:	Seeking support and resources for climate-resilient planning and actions.	Their participation is crucial for the success of adaptation initiatives.	Lack of resources and influence to engage effectively in climate-resilient planning.

This stakeholder analysis provides insights into the diverse interests, influences, and concerns of key stakeholders involved in the LoGIC project, which can be crucial for effective project management and stakeholder engagement.

4.3.3 Effectiveness of stakeholder engagement

The stakeholder analysis conducted for the LoGIC project reveals the effectiveness of stakeholder engagement across various dimensions, contributing significantly to the project's success.

Firstly, the project demonstrates a comprehensive understanding of the diverse range of stakeholders involved in climate resilience initiatives, including local government institutions (LGIs), communities, marginalized groups, civil society organizations (CSOs), and international partners like UNDP, UNCDF, and donor agencies. By systematically identifying, analyzing, and prioritizing these stakeholders, the project ensures inclusive decision-making and resource allocation, essential for achieving project objectives with broader societal relevance. Secondly, the project's strategic alignment with national priorities and collaboration with relevant ministries and government bodies, such as the Ministry of Local Government, Rural Development and Cooperatives (MoLGRD&C), Ministry of Environment and Forest, and Ministry of Disaster Management and Relief, underscores its effectiveness in navigating political pressures and optimizing the scale of interventions. This collaborative approach ensures that the project's activities are aligned with broader policy frameworks and contribute to national-level climate resilience efforts.

Thirdly, the project's engagement with local communities and vulnerable households demonstrates its commitment to inclusivity and empowerment. By targeting approximately 500,000 vulnerable households across Bangladesh's climate-vulnerable districts, the project ensures that climate adaptation strategies are tailored to local needs and priorities. The establishment of Climate-Resilient Cooperatives and the provision of training and support to vulnerable beneficiaries further enhance community resilience and livelihood diversification, with a particular focus on women empowerment. Furthermore, the project's governance and management arrangements, including the establishment of a steering committee and project board comprising representatives from relevant ministries, ensure effective oversight and strategic guidance. The recruitment of a Project Coordinator (PC) accountable to the National Project Director (NPD) and supported by technical experts from UNDP and UNCDF enhances project management and quality assurance, while also fostering collaboration with development partners and government agencies.

At the field level, the project's engagement with district and sub-district level officials, as well as Union Parishad (UP) representatives, facilitates the smooth implementation of project activities and ensures alignment with local development priorities. The coordination mechanism led by Union Parishad (UP) officials further enhances project coordination and avoids duplication of efforts. Overall, the LoGIC project's effectiveness in stakeholder engagement lies in its inclusive approach, strategic alignment with national priorities, and robust governance and management arrangements, which collectively contribute to its success in enhancing climate resilience at the local level.

Also, in order to understand overall engagement of stakeholders at root level with the beneficiaries the study team asked the beneficiaries a few questions. The response is given below.

Table 44: *Percentage of respondent's perception on the level of effectiveness of Community Mobilization Facilitators in contributing to the CALO they are involved in. (Response in %, N=1011)*

The above table provides a detailed look at the perceived effectiveness of Community Mobilization Facilitators (CMFs) in supporting Climate Adaptive Livelihood Options (CALOs) across different districts in Bangladesh. The responses from CALO farmers highlight varying levels of CMF effectiveness, with some districts showing significant satisfaction while others indicate areas for improvement. For instance, Patuakhali stands out with an impressive 96% of respondents rating CMFs as moderately effective and only 4% as very effective, suggesting a strong but not optimal impact. In contrast, Barguna displays overwhelming satisfaction with 83.2% perceiving CMFs as very effective, which is notably high compared to other districts.

District	Not effective at all	Slightly effective	Moderately effective	Very effective	Extremely effective
Khulna	0	6.3	52.4	22.1	19.2
Bagerhat	0	23.7	53.5	22.8	0
Barguna	1.1	3.2	11.6	83.2	1.1
Patuakhali	0	0	96	4	0
Bhola	17.6	11.1	35.7	32.7	3
Kurigram	0	1.2	23	58.2	17.6
Sunamganj	1.4	5.6	39.4	51.4	2.1
Total	3.8	7.8	39.9	39.6	9

Conversely, Bhola shows the highest discontent, with 17.6% of respondents finding CMFs not effective at all. The aggregated data from all districts reveal that a majority of respondents find CMFs moderately to very effective, with overall ratings of 39.9% and 39.6% respectively. However, the total 3.8% rating for CMFs being not effective at all, alongside the varied responses across districts, suggests a need for targeted improvements in specific areas. These findings indicate that while CMFs are generally effective in aiding CALO implementation, their impact is inconsistent across regions, which could be due to differences in training, resources available to CMFs, or local challenges. In conclusion, while the effectiveness of CMFs is generally positive, the variation highlights the importance of context-specific strategies and the need for continuous monitoring and adaptation of facilitation approaches to enhance the success of CALOs across all districts.

Table 45: *Percentage of respondents' perception on the level of effectiveness of Government line departments (Department of Agricultural Extension, Department of Fisheries and Department of Livestock) in contributing to the CALO they are involved in. (Response in percentage, N=1011)*

District	Not effective at all	Slightly effective	Moderately effective	Very effective	Extremely effective
Khulna	18.5	42.1	19.9	10.7	8.9
Bagerhat	4.4	52.6	34.2	7.9	0.9
Barguna	2.1	43.2	49.5	5.3	0
Patuakhali	0	56	44	0	0
Bhola	30.2	19.1	28.6	22.1	0
Kurigram	0	4.2	45.5	38.8	11.5
Sunamganj	18.3	47.2	24.5	5.6	1.4
Total	14.1	33.7	31.8	15.7	4.5

The above table details the perceptions of CALO farmers regarding the effectiveness of Government line departments (Department of Agricultural Extension, Department of Fisheries, and Department of Livestock) in supporting Climate Adaptive Livelihood Options (CALOs) across various districts in Bangladesh. The table presents a mixed picture of effectiveness, with significant variations in responses across districts. For example, in Patuakhali, a majority of respondents rated the departments' effectiveness as moderately to slightly effective, with 56% and 44% respectively, indicating a substantial engagement but lacking in comprehensive support since no responses were recorded for 'very effective' or 'extremely effective'. On the other hand, Bhola displayed the highest level of dissatisfaction, with 30.2% of respondents considering the departments not effective at all, yet 22.1% found them very effective, suggesting a polarized perception of government intervention. Overall, the data from all districts combined shows that 33.7% of respondents found government line departments slightly effective, and 31.8% moderately effective, indicating a moderate level of satisfaction with government support in the implementation of CALOs. The significant percentage (14.1%) of respondents perceiving these departments as not effective at all underscores a critical area for improvement. These findings highlight the need for government line departments to enhance their support mechanisms and align more closely with the specific needs and challenges of CALO initiatives. Improving training, resources, and on-ground support could address the inconsistencies in effectiveness and increase the impact of government departments on the successful implementation of CALOs across the regions.

Table 46: *Percentage of respondent's perception on accessibility of Community Mobilization Facilitators when they needed support or assistance for their CALO. (Response in %, N=1011)*

District	Not accessible at all	Slightly accessible	Moderately accessible	Very accessible	Extremely accessible
Khulna	0	3.3	46.5	28.8	21.4
Bagerhat	0	20.2	42.1	37.7	0
Barguna	0	2.1	6.3	74.7	16.8
Patuakhali	0	0	92	8	0
Bhola	17.6	5.5	41.2	31.7	4
Kurigram	0	0	23.6	59.4	17
Sunamganj	0	8.5	35.2	53.5	2.8
Total	3.5	5.6	37	42.6	11.3

The above table offers an insight into how CALO farmers across various districts in Bangladesh perceive the accessibility of Community Mobilization Facilitators (CMFs) when they require support or assistance. The results indicate varying levels of accessibility, with most districts showing a positive trend towards CMFs being at least moderately accessible. Notably, Patuakhali stands out with an impressive 92% of respondents rating CMFs as moderately accessible, though very few (8%) considered them very accessible, and none found them extremely accessible, highlighting a potential area for enhanced engagement and support. Conversely, Bhola shows significant challenges, with the highest rate of respondents (17.6%) reporting CMFs as not accessible at all, which could indicate logistical or operational issues hindering effective communication and assistance. Overall, the aggregated data for all districts reveals that a majority of respondents find CMFs accessible to some degree, with 42.6% rating them as very accessible and 11.3% as extremely accessible. However, the 3.5% finding them not accessible at all underscores the necessity for improved outreach and availability of CMFs to ensure that all farmers

can benefit equally from their support. This suggests that while the framework for CMF support is largely effective, specific regions like Bhola require targeted interventions to improve access and effectiveness, ensuring that CMFs are a reliable resource for all CALO farmers. Enhanced training and resource allocation for CMFs could help bridge the accessibility gaps and foster more robust support networks for adaptive livelihood practices.

Table 47: *Percentage of respondent's perception on accessibility of the Government line departments (Department of Agricultural Extension, Department of Fisheries and Department of Livestock) when they needed support or assistance for their CALO. (Response in %, N=1011)*

District	Not accessible at all	Slightly accessible	Moderately accessible	Very accessible	Extremely accessible
Khulna	35.4	28	17	10	9.6
Bagerhat	5.3	46.5	34.2	10.5	3.5
Barguna	5.3	44.2	48.4	2.1	0
Patuakhali	12	68	20	0	0
Bhola	30.2	19.1	27.6	23.1	0
Kurigram	0.6	4.8	45.5	40.6	8.5
Sunamganj	21.1	49.3	23.2	6.3	0
Total	19.9	30.1	29.6	16.1	4.4

The above analysis explores the accessibility of various government line departments (Department of Agricultural Extension, Department of Fisheries, and Department of Livestock) as perceived by CALO farmers across different districts in Bangladesh. The data highlights significant discrepancies in accessibility across regions, which could influence the effectiveness of CALO implementation. In districts like Kurigram, accessibility appears robust with 89.6% of respondents finding these departments from moderately to extremely accessible. This contrasts sharply with Patuakhali, where a substantial 68% of respondents only find these departments slightly accessible and none find them very or extremely accessible, signaling major accessibility issues. Notably, Khulna and Bhola show a significant portion of respondents considering these departments not accessible at all, at 35.4% and 30.2% respectively, which could hamper the successful implementation of CALOs due to lack of support and guidance. On the other hand, Barguna shows a better scenario where nearly half of the respondents find the departments moderately accessible. The total overview shows that a majority of respondents find the departments only slightly to moderately accessible, with a low percentage rating them as very or extremely accessible. Conclusively, the findings suggest a critical need for improved engagement and accessibility strategies by government line departments to enhance support for CALO initiatives. Enhancing accessibility not only in terms of physical availability but also in responsiveness and effective communication could significantly improve the implementation success of CALOs across Bangladesh. Stakeholder engagement strategies, particularly in regions like Patuakhali, Khulna, and Bhola, need urgent reassessment to address the gaps identified, ensuring that governmental support structures are effectively bolstering the adaptive capacities of rural agricultural communities.

Table 48: Percentage of respondent's perception on the level of impact CMFs support had in the success of their CALO project. (Response in %, N=1011)

District	No impact	low impact	Moderate impact	high impact	very high impact
Khulna	0.4	4.1	55.7	14.8	25.1
Bagerhat	0	16.7	50.9	30.7	1.8
Barguna	20	4.2	13.7	60	2.1
Patuakhali	40	28	32	0	0
Bhola	19.1	4	40.2	34.7	2
Kurigram	0.6	0	20.6	64.8	13.9
Sunamganj	0.7	6.3	46.5	45.1	1.4
Total	6.9	5.7	40.6	36.8	10.0

The above table evaluates the perceived impact of Community Mobilization Facilitators (CMFs) on the success of Climate Adaptive Livelihood Options (CALOs) across several districts in Bangladesh, providing insights into how essential these facilitators are in the effective implementation of these projects. The results vary significantly across districts, indicating varied experiences with CMF support. In districts like Kurigram, a high percentage of respondents (78.7%) report high to very high impact, showcasing the effectiveness of CMF support in enhancing the success of CALOs. Conversely, Patuakhali presents a stark contrast, with 68% of respondents indicating no to low impact, highlighting issues possibly related to the quality or intensity of CMF engagement. Barguna and Sunamganj also display noteworthy results; in Barguna, 62.1% perceive high to very high impact, whereas in Sunamganj, a substantial 46.5% only see a moderate impact. This disparity suggests that the effectiveness of CMFs can be significantly influenced by regional operational conditions, or the specific challenges faced within individual districts. The overall data shows that while the majority (77.4%) feel CMFs have at least a moderate impact on CALO success, there remains a substantial proportion across the districts that experience lower impacts, underscoring the need for targeted improvements in CMF strategies. The concluding remark is that while CMFs generally play a positive role in supporting CALO projects, the variability in perceived impact across districts necessitates a tailored approach to enhance their effectiveness. Strengthening training for CMFs, ensuring they are well-equipped to address local-specific challenges, and enhancing their accountability might increase their impact, especially in areas like Patuakhali where their influence is currently viewed as limited. This alignment and enhancement of stakeholder roles are critical for the robust implementation and success of climate adaptation initiatives across varied geographic and socio-economic contexts in Bangladesh.

Table 49: Percentage of respondent's perception on the level of impact Government line departments support had in the success of their CALO project. (Response in %, N=1011)

District	No impact	low impact	Moderate impact	high impact	very high impact
Khulna	35.8	24.7	19.6	9.6	10.3
Bagerhat	4.4	55.3	31.6	7.9	0.9
Barguna	21.1	30.5	43.2	5.3	0
Patuakhali	44	52	4	0	0
Bhola	27.6	21.1	29.6	21.6	0
Kurigram	0	3.6	42.4	43.6	10.3
Sunamganj	17.6	38.7	33.8	9.9	0
Total	21.1	27.2	30.5	16.7	4.5

The above table provides an analysis of how farmers perceive the impact of support from Government line departments on the success of Climate Adaptive Livelihood Options (CALOs) across several districts in Bangladesh. The data reveals a mixed response, with significant variations in perception across different districts, which highlights the inconsistencies in the effectiveness of government support. For instance, Kurigram shows a promising scenario where 54.1% of respondents perceive high to very high impact, indicating effective government intervention. On the other hand, Patuakhali exhibits a starkly different picture, with 96% of respondents feeling that government support had no or low impact on their CALO projects, pointing towards significant gaps in effective government engagement or support mechanisms. Furthermore, districts like Khulna and Bhola also show a considerable percentage of respondents (60.5% and 48.7% respectively) viewing government support as having no or low impact, suggesting that improvements are needed in the government's approach to supporting CALOs. The overall trend across all districts indicates that more than half of the respondents feel the impact of government departments is moderate to very high, but the substantial percentage noting low or no impact cannot be overlooked. This data underscores the need for a more consistent and impactful approach from government departments to effectively support CALO initiatives. Conclusively, while there is evidence of some positive impact, the significant variance across districts calls for a strategic review and enhancement of government support structures to ensure uniform effectiveness. Enhancing coordination, increasing resources, and tailoring approaches to meet local needs may lead to better outcomes in CALO implementation and success. Aligning these efforts with stakeholder needs and regional specifics as revealed by the survey can lead to more substantial and impactful support, thereby fostering greater success in CALO projects across Bangladesh.

The variability in effectiveness, accessibility, and impact reported by respondents across different districts indicates a need for more tailored and responsive strategies. While some areas report high levels of effectiveness and positive impact, particularly in districts like Kurigram and Barguna, others like Patuakhali and Bhola show considerable gaps in support and accessibility. This inconsistency underscores the importance of understanding regional differences and adapting strategies accordingly to improve the overall success of CALO initiatives.

To enhance the implementation and success rates of future CALO initiatives, UNDP should consider implementing a few strategic recommendations. First, there is a clear need for capacity building and increased training for CMFs to ensure they are better equipped to support CALO initiatives effectively. This training should be customized to address the specific challenges of each district.

Additionally, strengthening the collaboration and communication channels between local government line departments and CALO projects can ensure more coherent and supportive engagement. Finally, implementing a robust monitoring and evaluation framework that regularly assesses the impact of these initiatives can help identify areas of improvement early and allow for real-time adjustments. These measures will ensure that the support provided to CALO projects is not only consistent but also effectively meets the diverse needs of different regions, leading to more sustainable and impactful outcomes.

4.3.4 Stakeholders' influence over Cross-Sectional issues

Strategic Stakeholders (National Level)

Influence on Policy and Funding: National stakeholders like the LGD and international partners influence policies and funding allocations that support CALO implementation. Their strategic guidance helps address macroeconomic challenges, ensuring the sustainability of initiatives like Maize Cultivation, which show positive economic impacts.

Tactical Stakeholders

Design and Technical Support: UNDP and UNCDF provide the necessary technical support and innovation required for effective CALO implementation. Their involvement ensures that projects are scientifically sound and practically feasible, enhancing their resilience and adaptability.

Operational Stakeholders (Local Level)

Implementation and Capacity Building: LGIs and CSOs at the local level execute climate-resilient plans and provide training. The effectiveness of Community Mobilization Facilitators (CMFs) and local government departments in delivering support directly influences the success and sustainability of CALOs. For instance, CALOs like Vermicompost and Sunflower Cultivation show varying degrees of effectiveness in stakeholder support, impacting their overall success and sustainability.

Community Stakeholders

Beneficiary Engagement: Involving local communities, particularly vulnerable households and women, is critical for tailoring CALO interventions to local needs. Community feedback and participation ensure that initiatives like Climate-Resilient Cooperatives address specific challenges faced by beneficiaries, enhancing their adaptive capacity and financial stability.

Partnerships

Enhanced Capacity and Market Access: Collaborations with organizations like BRAC and BUET provide beneficiaries with valuable skills, financial inclusion, and access to markets. These partnerships are essential for the success of CALOs, as evidenced by significant impacts on income and expenditure patterns among beneficiaries.

The stakeholder analysis reveals a comprehensive and inclusive approach to implementing CALOs, with strategic, tactical, and operational stakeholders playing crucial roles at various levels. The cross-sectional analysis highlights the diverse economic impacts of different CALOs, emphasizing the need for tailored support and effective stakeholder engagement. By aligning stakeholder roles with the specific needs and contexts of individual CALO projects, the initiatives can achieve long-term success and sustainability, enhancing the livelihoods and resilience of vulnerable communities in climate-stressed areas of Bangladesh.

Chapter 5
Cross-sectional analysis of CALOs

This chapter provides a detailed analysis on cross-sectional analysis of CALOs considering climate hotspots, geographical conditions, socio-economic context of beneficiaries and adaptive capacity.

5.1 Economic Impact on Households

5.1.1 Income Changes

Firstly, this chapter will explore the economic impact of CALOs on households. The CRF beneficiaries were asked if they have noticed any changes in their financial condition. The findings revealed that those who are involved in Maize Cultivation and Native Poultry Rearing, 60.8% and 63.3% of them respectively reported increased income. Activities such as Native Chicken Rearing and F-1 Calf Rearing also report strong income boosts, at 47.8% and 53.3% respectively, coupled with substantial enhancements in credit access (14.3% and 20.0%). On the other hand, Brackishwater Fish Polyculture and Stress Tolerant Vegetable Cultivation stand out for significantly improving savings (36.2% and 22.5%) and credit access. However, challenges are apparent in certain CALOs; for instance, Sunflower cultivation and Watermelon Cultivation show considerable portions of participants experiencing negligible economic change, with 84% and 48% reporting no significant shifts, respectively.

Table 50: Perception on respondents noticed changes in their financial condition by categories of CALO (Response in %, multiple response, N=1011)

CALO Name	Increased Income	Improved Access to Credit	Enhanced Savings	More Investment Opportunities	No Significant Change	Decreased Income	Reduced Access to Credit	Decreased Savings
Crab fattening	31	4.2	32.4	32.4	0	0	0	0
Carp fish polyculture	26.1	12	21.7	14.1	26.1	0	0	0
Sheep rearing	38.3	6	26.9	25.1	3	0	0.6	0
Pig rearing	37.3	6.8	30.5	25.4	0	0	0	0
Integrated Agriculture and Poultry	29.7	10.3	26.7	21.5	4.6	2.6	2.1	2.6
Duck and Fish farming	27.9	21.3	19.9	14	10.3	2.2	2.9	1.5
Integrated agriculture farming	34.9	17.6	29.8	17.6	0	0	0	0
Green Job (Bamboo-based Handicraft)	48.5	0	39.4	12.1	0	0	0	0
Duck rearing	32	0	18.7	21.3	26.7	1.3	0	0
Maize Cultivation	60.8	10.1	25.3	3.8	0	0	0	0
Integrated vegetable cultivation	37.2	15.5	25.6	11.6	10.1	0	0	0
Mung bean cultivation	37.1	1.6	30.6	30.6	0	0	0	0
Watermelon cultivation	48	4	0	0	48	0	0	0
Vermicompost	30.8	7.7	12.8	10.3	38.5	0	0	0
Saline water fisheries	27.3	16.9	29.9	24.7	1.3	0	0	0
Sheep and Duck rearing	30.1	18.5	27.4	20.5	3.4	0	0	0
Brackishwater Fish Polyculture	40	9.5	36.2	13.3	1	0	0	0
Stress Tolerant Vegetable	35.7	18.1	22.5	20.3	3.3	0	0	0
Sunflower cultivation	4	8	4	0	84	0	0	0
Native Poultry Rearing	63.3	3.3	16.7	0	16.7	0	0	0
Native Chicken Rearing	47.8	14.3	18.6	11.8	6.8	0	0	0.6
F-1 Calf Rearing	53.3	20	26.7	0	0	0	0	0
Total	36.2	12.5	25.4	17.3	7.3	0.4	0.4	0.4

In terms of agro-ecological zones, In the Ganges Tidal Floodplain, 34.1% of participants reported increased income, with significant improvements also observed in savings (25.1%) and investment opportunities (20.8%). However, a small fraction (8.8%) experienced no significant change in their economic conditions. In the Young Meghna Estuarine Floodplain, there is a notable distribution across economic impacts with 31.1% reporting increased income and 25.3% enhanced savings. This region also shows a higher improvement in credit access (19.2%), though it faces some challenges as indicated by the 1.7% of participants who reported decreased income, reduced access to credit, and decreased savings. The Active Tista Floodplain demonstrates the highest increase in income at 54.1%, although the improvement in investment opportunities is relatively low at 3.9%. The area shows minimal negative impacts with no reported decrease in income or savings. Lastly, the Sylhet Basin shows a balanced improvement across most economic metrics, with 35.8% experiencing an increase in income and over 26.5% reporting enhanced savings. Investment opportunities also grew significantly at 23.5%.

Table 51: Perception on respondents noticed changes in their financial condition by agroecological zones (Response in %, multiple response, N=1011)

CALO Name	Increased Income	Improved Access to Credit	Enhanced Savings	More Investment Opportunities	No Significant Change	Decreased Income	Reduced Access to Credit	Decreased Savings
Ganges Tidal Floodplain	34.1	11.2	25.1	20.8	8.8	0	0.1	0
Young Meghna Estuarine Floodplain	31.1	19.2	25.3	12.9	6.5	1.7	1.7	1.7
Active Tista Flood plain	54.1	12.8	25.6	3.9	3.6	0	0	0
Sylhet Basin	35.8	7.1	26.5	23.5	6.8	0.3	0	0
Total	36.2	12.5	25.4	17.3	7.3	0.4	0.4	0.4

The respondents were then asked if they would attribute these changes to their involvement with CALO. The data on whether respondents attribute their economic changes to their involvement with CALO activities revealed variations in perception across different CALOs. Some activities such as Crab Fattening, Pig Rearing, Green Job (Bamboo-based Handicraft), Integrated Agriculture Farming and Brackishwater Fish Polyculture exhibit extremely high attribution, with 100% and 95.8% of participants respectively affirming that their economic improvements are directly linked to their involvement in these CALOs. Conversely, some activities show a divided perception among participants. For instance, for Carp Fish Polyculture, 49% attribute economic changes to CALO involvement and 51% not making that connection. Similarly, F-1 Calf Rearing shows a greater number of participants (54.2%) who do not believe their involvement has led to economic changes compared to those who do (45.8%). Notably, certain activities like Sunflower Cultivation and Vermicompost have a majority of respondents not attributing any significant change to CALO involvement, with 100% and 72.4% respectively.

Table 52: If respondents would attribute these changes to their involvement with CALO (Response in %, N=1011)

CALO Name	Yes	No
Crab fattening	100	0
Carp fish polyculture	49	51
Sheep rearing	75	25
Pig rearing	100	0
Integrated Agriculture and Poultry	74	26
Duck and Fish farming	66.7	33.3
Integrated agriculture farming	95.9	4.1
Green Job (Bamboo-based Handicraft)	100	0
Duck rearing	54.2	45.8
Maize Cultivation	72.9	27.1
Integrated vegetable cultivation	71.4	28.6
Mung bean cultivation	95.8	4.2
Watermelon cultivation	20.8	79.2
Vermicompost	27.6	72.4
Saline water fisheries	95.8	4.2
Sheep and Duck rearing	81.6	18.4
Brackishwater Fish Polyculture	95.8	4.2
Stress Tolerant Vegetable (brinjal, rice,red-amaranth, cucumber .)	94.4	5.6
Sunflower cultivation	0	100
Native Poultry Rearing	79.2	20.8
Native Chicken Rearing	90.3	9.7
F-1 Calf Rearing	45.8	54.2
Total	75.5	24.5

Those who said 'yes', were further asked how CALO helped to change their financial situation. The findings show that many CALOs have effectively introduced new agricultural techniques leading to higher crop yields and increased sales. Notably, Watermelon Cultivation shows the highest impact, with 80% of respondents reporting benefit from adopted techniques. Other significant impacts are seen in Maize Cultivation and Integrated Vegetable Cultivation with 46.1% and 44.8% respectively. Besides, CALOs have also played a crucial role in connecting beneficiaries with financial institutions. Integrated Vegetable Cultivation stands out with 28.7% of respondents noting this benefit, followed closely by Brackishwater Fish Polyculture and Stress Tolerant Vegetable Cultivation, both around 28%. A substantial number of beneficiaries reported that increased income from CALO activities allowed them to save more. The highest reported impact was from F-1 Calf Rearing with a remarkable 83.3% of respondents experiencing this benefit. Crab Fattening and Pig Rearing also saw significant responses at 53.8% and 52.8% respectively. Several respondents acknowledged CALO's role in introducing new agricultural technologies or practices worth investing in, including Duck Rearing at 27.3%, and Carp Fish Polyculture at 22.4%.

Table 53: Respondent's perception on how CALO help them to change their financial situation (Response in %, multiple response, N=763)

CALO Name	Adopted new agricultural techniques learned from CALO, leading to higher crop yields and sales	CALO facilitated connections with financial institutions that offered loans tailored to farmers.	Increased income from CALO activities allowed me to save more.	CALO introduced me to new agricultural technologies or practices that were worth investing in
Crab fattening	23.1	23.1	53.8	0
Carp fish polyculture	38.8	26.5	12.2	22.4
Sheep rearing	33	17.6	40.7	8.8
Pig rearing	22.2	19.4	52.8	5.6
Integrated Agriculture and Poultry	34.8	12.3	31.9	21
Duck and Fish farming	25.3	23.2	35.4	16.2
Integrated agriculture farming	42.1	26.6	21.5	9.8
Green Job (Bamboo -based Handicraft)	44.4	22.2	33.3	0
Duck rearing	27.3	6.8	38.6	27.3
Maize Cultivation	46.1	15.8	26.3	11.8
Integrated vegetable cultivation	44.8	28.7	25.3	1.1
Mung bean cultivation	34.3	3	28.4	34.3
Watermelon cultivation	80	20	0	0
Vermicompost	26.7	6.7	33.3	33.3
Saline water fisheries	28.1	28.1	35.1	8.8
Sheep and Duck rearing	29.7	27.5	31.9	11
Brackishwater Fish Polyculture	43.3	28.9	25.8	2.1
Stress Tolerant Vegetable (	38	27.6	19.6	14.7
Native Poultry Rearing	43.3	20	36.7	0
Native Chicken Rearing	37.9	23.1	26.4	12.6
F-1 Calf Rearing	8.3	8.3	83.3	0
Total	36.4	21.9	29.4	12.3

5.1.2 Changes in expenditure pattern

The beneficiaries were also asked about changes in expenditure pattern since joining CALO. The findings show that, impact of CALO engagement on expenditure patterns varies significantly across different CALO. For instance, Green Job stands out with all participants reporting an increase in expenditure. Similarly, Native Poultry Rearing and Sheep and Duck Rearing also show very high rates of increased expenditures, at 87.5% and 83.7% respectively. In contrast, activities like F-1 Calf Rearing exhibit that 50% of respondents reporting decreased expenditures, On the other hand, Sunflower Cultivation and Watermelon Cultivation show a predominance of stable expenditures, with 70.8% and 54.2% of participants respectively indicating no change, suggesting that these activities might not require significant additional outlays beyond initial setups.

Table 54: Change in expenditure after CALO engagement by categories of CALO engagement (Response in %, N=1011)

CALO	Expenditure increased	Expenditure remained the same	Expenditure decreased
Crab fattening	41.7	8.3	50
Carp fish polyculture	59.2	14.3	26.5
Sheep rearing	52.8	13.9	33.3
Pig rearing	50	4.2	45.8
Integrated Agriculture and Poultry	79.5	19.2	1.4
Duck and Fish farming	63.5	14.3	22.2
Integrated agriculture farming	67	6.2	26.8
Green Job (Bamboo-based Handicraft)	100	0	0
Duck rearing	56.3	41.7	2.1
Maize Cultivation	60.4	14.6	25
Integrated vegetable cultivation	30.2	38.1	31.7
Mung bean cultivation	79.2	16.7	4.2
Watermelon cultivation	45.8	54.2	0
Vermicompost	41.4	44.8	13.8
Saline water fisheries	79.2	20.8	0
Sheep and Duck rearing	83.7	16.3	0
Brackishwater Fish Polyculture	75	0	25
Stress Tolerant Vegetable	60.6	18.3	21.1
Sunflower cultivation	29.2	70.8	0
Native Poultry Rearing	87.5	12.5	0
Native Chicken Rearing	67.7	16.1	16.1
F-1 Calf Rearing	4.2	45.8	50
Total	60.9	20	19.1

In terms of agro-ecological zone, In the Sylhet Basin, a significant 79.6% of participants reported an increase in expenditures, with no respondents reporting decreased expenditures. Conversely, the Active Tista Flood plain shows a strikingly different pattern, where the majority of participants (54.5%) experienced a decrease in expenditure. Only 19.4% reported increased expenditure. The Ganges Tidal Floodplain and the Young Meghna Estuarine Floodplain show more balanced outcomes but still lean towards increased expenditures at 68.5% and 62.8%, respectively. In these zones, a notable proportion of participants also experienced decreased expenditures, particularly in the Young Meghna Estuarine Floodplain at 25.1%.

Table 55: Change in expenditure after CALO engagement by agro-ecological zones (Response in %, N=1011)

Agro-ecological zone	Expenditure increased	Expenditure remained the same	Expenditure decreased
Ganges Tidal Floodplain	68.5	21	10.5
Young Meghna Estuarine Floodplain	62.8	12.1	25.1
Active Tista Flood plain	19.4	26.1	54.5
Sylhet Basin	79.6	20.4	0
Total	60.9	20	19.1

Those who replied that their expenditure has increased were further asked about CALO's direct role behind the increase in expenditure. The findings show that, several CALOs such as Crab Fattening, Pig Rearing, Integrated Agriculture Farming, Green Job (Bamboo-based Handicraft), Maize Cultivation, Watermelon Cultivation, Vermicompost, Saline Water Fisheries, Native Poultry Rearing, and F-1 Calf Rearing see 100% of participants attributing an increase in expenditure directly to their CALO involvement. Other CALOs like Sheep Rearing and Duck Rearing show strong recognition of CALO's impact at 84.2% and 81.5% respectively, while a smaller fraction remains unsure or disagrees. Conversely, Carp Fish Polyculture presents a more divided response with 44.8% acknowledging CALO's role and 48.3% denying it.

Table 56: Recognition of CALO's direct role behind the increase in expenditure by categories of CALO engagement (Response in %, N=616)

CALO Name	Yes	No	Not sure
Crab fattening	100	0	0
Carp fish polyculture	44.8	48.3	6.9
Sheep rearing	84.2	5.3	10.5
Pig rearing	100	0	0
Integrated Agriculture and Poultry	86.2	13.8	0
Duck and Fish farming	70	25	5
Integrated agriculture farming	100	0	0
Green Job (Bamboo-based Handicraft)	100	0	0
Duck rearing	81.5	14.8	3.7
Maize Cultivation	100	0	0
Integrated vegetable cultivation	89.5	10.5	0
Mung bean cultivation	63.2	36.8	0
Watermelon cultivation	100	0	0
Vermicompost	100	0	0
Saline water fisheries	100	0	0
Sheep and Duck rearing	90.2	2.4	7.3
Brackishwater Fish Polyculture	94.4	2.8	2.8
Stress Tolerant Vegetable	95.3	4.7	0
Sunflower cultivation	71.4	28.6	0
Native Poultry Rearing	100	0	0
Native Chicken Rearing	88.9	9.5	1.6
F-1 Calf Rearing	100	0	0
Total	88.1	9.6	2.3

With regards to agro-ecological zones, Active Tista Flood plain stands out distinctly, with 100% of the respondents acknowledging a direct role of CALO in increasing their expenditures. Ganges Tidal Floodplain also shows a high level of acknowledgment, with 91.6% of participants affirming CALO's role in their increased expenditures. In the Sylhet Basin, 88.5% of respondents recognize CALO's impact on increased expenditures. The Young Meghna Estuarine Floodplain shows a more mixed perception with 75.2% attributing expenditure increases to CALO, while 23.2% do not see a direct connection.

Table 57: Recognition of CALO's direct role behind the increase in expenditure by agro-ecological zones (Response in %, N=616)

Agro-ecological zone	Yes	No	Not sure
Ganges Tidal Floodplain	91.6	7.2	1.2
Young Meghna Estuarine Floodplain	75.2	23.2	1.6
Active Tista Flood plain	100	0	0
Sylhet Basin	88.5	4.4	7.1
Total	88.1	9.6	2.3

The distribution of increased expenditure across various CALO engagements showcases distinct patterns. The highest priority in terms of increased spending across almost all CALOs is on food, at 87% in total, with Native Poultry Rearing showing the highest percentage at 45.5%. Spending on healthcare is also significant, at 69.5% in total, with Crab Fattening showing the highest allocation at 40%. Expenditure on children's education is another major category, at 71.6% in total, with Integrated Vegetable Cultivation leading at 37.5%.

Table 58: Distribution of increased expenditure by categories of CALO engagement (Response in %, N=616, multiple response)

CALO Name	expenditure on child's education	expenditure on Food	expenditure on healthcare	expenditure on farming	Household expenditure increased because of price hike
Crab fattening	20	36	40	4	0
Carp fish polyculture	16.7	31.9	30.6	12.5	8.3
Sheep rearing	27.2	30.1	27.2	15.5	0
Pig rearing	34.3	34.3	28.6	2.9	0
Integrated Agriculture and Poultry	24.4	27.8	25.8	22	0
Duck and Fish farming	27.3	35.5	20.9	16.4	0
Integrated agriculture farming	30.1	25.4	29	15.5	0
Green Job (Bamboo-based Handicraft)	25.7	37.1	31.4	5.7	0
Duck rearing	23.1	33.8	15.4	24.6	3.1
Maize Cultivation	31.6	40.4	19.3	8.8	0
Integrated vegetable cultivation	37.5	35	20	7.5	0
Mung bean cultivation	14	24	24	30	8
Watermelon cultivation	19.2	42.3	30.8	7.7	0
Vermicompost	19.5	29.3	26.8	24.4	0
Saline water fisheries	25	31.7	30	13.3	0
Sheep and Duck rearing	27.1	29.7	24.6	17.8	0.8
Brackishwater Fish Polyculture	27.8	44.4	26.4	1.4	0
Stress Tolerant Vegetable	27.8	27.8	25.2	19.2	0
Sunflower cultivation	15.8	36.8	36.8	10.5	0
Native Poultry Rearing	27.3	45.5	24.2	3	0
Native Chicken Rearing	30.7	38	22.7	8.7	0
F-1 Calf Rearing	33.3	33.3	33.3	0	0
Total	71.6	87	69.5	40.4	2.1

In terms of agro-ecological zones, in the Ganges Tidal Floodplain, 66.20% of respondents increased spending on their child's education, 87.60% on food, 65.90% on healthcare, 37.60% on farming, and 3.50% reported increases due to price hikes. The Young Meghna Estuarine Floodplain saw 78.40% increase expenditure on education, 97.60% on food, 84.80% on healthcare, and 36.80% on farming. In the Active Tista Flood plain, 90.60% increased spending on education, 71.90% on food, 56.30% on healthcare, and 25.00% on farming, also with no increases due to price hikes. The Sylhet Basin showed that 75.20% of respondents increased spending on education, 77.90% on food, 67.30% on healthcare, 57.50% on farming. Across all zones, the overall trends show significant increases in expenditure on education (71.60%), food (87.00%), and healthcare (69.50%), with farming (40.40%) and price hikes (2.10%) being less impactful on household spending.

Table 59: Distribution of increased expenditure by agro-ecological zones (Response in %, N=616, multiple response)

Agro-ecological zones	expenditure on child's education	expenditure on Food	expenditure on healthcare	expenditure on farming	Household expenditure increased because of price hike
Ganges Tidal Floodplain	66.2	87.6	65.9	37.6	3.5
Young Meghna Estuarine Floodplain	78.4	97.6	84.8	36.8	0
Active Tista Flood plain	90.6	71.9	56.3	25	0
Sylhet Basin	75.2	77.9	67.3	57.5	0.9
Total	71.6	87	69.5	40.4	2.1

5.1.3 Employment opportunities

Respondent's perception on CALO creating more job opportunities in the communities were assessed with their level of agreement/disagreement with some statements. The results show varying levels of agreement across different agricultural and livestock activities. For instance, "Pig rearing" and "Maize Cultivation" received unanimous support with 100% of respondents agreeing that these activities create more jobs. Similarly, activities like "Crab fattening," "Green Job (Bamboo-based Handicraft)," and "Saline water fisheries" also saw high agreement rates at 100% for job creation. Other CALOs, like "Integrated agriculture farming" and "Stress Tolerant Vegetable Cultivation," also received high agreement levels at 84.5% and 91.5%, respectively. However, some activities like "Sunflower cultivation" and "Duck and Fish farming" faced more skepticism or disagreement, with "Sunflower cultivation" notably having 41.7% disagreeing on its job creation potential. Overall, the majority of sentiment is positive with 77.1% of total responses falling in the agree category, indicating a general optimism about CALOs contributing to local employment.

Table 60: Perception on CALO creating more job opportunity in the community (Response in %, N=1011)

CALO Name	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Crab fattening	0	0	0	91.7	8.3
Carp fish polyculture	0	30.6	18.4	51	0
Sheep rearing	1.4	0	23.6	66.7	8.3
Pig rearing	0	0	0	100	0
Integrated Agriculture and Poultry	15.1	1.4	5.5	78.1	0
Duck and Fish farming	22.2	1.6	0	66.7	9.5
Integrated agriculture farming	1	5.2	5.2	84.5	4.1
Green Job (Bamboo-based Handicraft)	0	6.3	0	93.8	0
Duck rearing	2.1	8.3	37.5	39.6	12.5
Maize Cultivation	0	0	0	100	0
Integrated vegetable cultivation	0	0	4.8	88.9	6.3
Mung bean cultivation	12.5	0	12.5	75	0
Watermelon cultivation	0	0	8.3	83.3	8.3
Vermicompost	3.4	27.6	17.2	41.4	10.3
Saline water fisheries	0	0	0	100	0
Sheep and Duck rearing	0	2	18.4	79.6	0
Brackishwater Fish Polyculture	0	0	14.6	85.4	0
Stress Tolerant Vegetable (brinjal, rice,red-amaranth, cucumber .)	0	0	7	91.5	1.4
Sunflower cultivation	20.8	41.7	16.7	16.7	4.2
Native Poultry Rearing	0	0	4.2	95.8	0
Native Chicken Rearing	11.8	1.1	8.6	77.4	1.1
F-1 Calf Rearing	0	0	4.2	95.8	0
Total	4.7	4.6	10	77.1	3.6

In terms of agro-ecological zones, in the Ganges Tidal Floodplain, a high majority (84.4%) believe that CALOs are creating more jobs, with 80.2% agreeing and 4.2% strongly agreeing, despite 9.5% expressing some level of disagreement. The Young Meghna Estuarine Floodplain shows a more mixed response, with 72.9% agreeing or strongly agreeing that there are job opportunities, but 18.1% strongly disagreeing, indicating significant skepticism. The Active Tista Floodplain exhibits a strong positive perception, with 96.4% agreeing or strongly agreeing on job creation, showing nearly unanimous support. Conversely, the Sylhet Basin presents the most varied responses: although 59.9% agree or strongly agree on job opportunities, a substantial 34.5% remain neutral, suggesting uncertainty or indifference about the impact of CALOs on employment in this region.

Table 61: Perception on CALO creating more job opportunity in the community (Response in %, N=1011)

CALO Name	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Ganges Tidal Floodplain	2.2	7.3	6.1	80.2	4.2
Young Meghna Estuarine Floodplain	18.1	1.5	7.5	71.9	1
Active Tista Flood plain	0	0	3.6	89.1	7.3
Sylhet Basin	0.7	4.9	34.5	59.2	0.7
Total	4.7	4.6	10	77.1	3.6

The study findings indicate diverse community perceptions regarding CALO initiatives helping young people find work in farming across various sectors, with a total of 1011 responses. Some CALOs show high levels of support, such as "F-1 Calf Rearing" and "Green Job (Bamboo-based Handicraft)," each with 100% agreement. Similarly, "Pig rearing" also sees significant approval with 91.7% agreeing and an additional 8.3% strongly agreeing with its efficacy in creating job opportunities for young people. Other sectors like "Crab fattening" and "Maize Cultivation" also show strong positive perceptions, with 87.5% and 97.9% agreement respectively, reflecting a general optimism about these sectors' impact on youth employment in farming. Conversely, "Mung bean cultivation" and "Watermelon cultivation" are sectors where the majority remain neutral, suggesting uncertainty or a lack of visible impact on job creation for the youth. On the other hand, "Sunflower cultivation" and "Vermicompost" receive much lower levels of support. In sunflower cultivation, only 16.7% agree or strongly agree that it helps young people find farming jobs, with a notable 45.8% outright disagreeing. Vermicompost also shows limited confidence with only 10.3% agreement and a substantial 20.7% disagreement.

Table 62: Perception on CALO helping young people in community finding work in farming (Response in %, N=1011)

CALO Name	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Crab fattening	0	0	0	87.5	12.5
Carp fish polyculture	0	18.4	30.6	51	0
Sheep rearing	12.5	6.9	13.9	62.5	4.2
Pig rearing	0	0	0	91.7	8.3
Integrated Agriculture and Poultry	15.1	1.4	20.5	63	0
Duck and Fish farming	22.2	3.2	6.3	54	14.3
Integrated agriculture farming	5.2	8.2	1	83.5	2.1
Green Job (Bamboo-based Handicraft)	0	0	0	100	0
Duck rearing	8.3	12.5	66.7	12.5	0
Maize Cultivation	0	0	2.1	97.9	0
Integrated vegetable cultivation	0	1.6	50.8	41.3	6.3
Mung bean cultivation	0	0	83.3	16.7	0
Watermelon cultivation	0	12.5	79.2	8.3	0
Vermicompost	0	20.7	69	10.3	0
Saline water fisheries	0	0	25	75	0
Sheep and Duck rearing	2	12.2	18.4	67.3	0
Brackishwater Fish Polyculture	0	0	27.1	72.9	0
Stress Tolerant Vegetable (brinjal, rice,red-amaranth, cucumber .)	0	0	14.1	84.5	1.4
Sunflower cultivation	8.3	45.8	29.2	12.5	4.2
Native Poultry Rearing	0	0	8.3	91.7	0
Native Chicken Rearing	16.1	5.4	12.9	64.5	1.1
F-1 Calf Rearing	0	0	0	100	0
Total	6.0	6.2	22.6	62.6	2.6

In terms of agroecological zones, In the Active Tista Flood plain, there is overwhelmingly positive feedback, with 96.9% of responses falling into the agree or strongly agree categories, indicating strong support for CALO's effectiveness in this zone. The Ganges Tidal Floodplain also shows a favorable view, though with a larger neutral response; 65.6% agree or strongly agree that CALOs help in job creation, while 28.1% remain neutral. Contrastingly, the Sylhet Basin exhibits the most skepticism, with 35.2% disagreeing or strongly disagreeing and only 41.5% in agreement regarding CALO's role in fostering employment. Similarly, the Young Meghna Estuarine Floodplain reflects mixed perceptions with 54.8% agreeing or strongly agreeing and 20.6% either disagreeing or strongly disagreeing, coupled with a notable 24.6% neutrality, indicating a considerable division in opinion.

Table 63: Perception on CALO helping young people in community finding work in farming by agro-ecological zines (Response in %, N=1011)

Agro-ecological zones	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Ganges Tidal Floodplain	0.6	5.7	28.1	62	3.6
Young Meghna Estuarine Floodplain	18.6	2	24.6	54.3	0.5
Active Tista Flood plain	0	0.6	2.4	93.3	3.6
Sylhet Basin	14.8	20.4	23.2	40.8	0.7
Total	6.0	6.2	22.6	62.6	2.6

The survey data on perceptions regarding whether other family members have been able to find more work due to CALO activities shows a varied response across different CALO initiatives. Notably, "F-1 Calf Rearing" received a very positive response with 100% of participants agreeing that it has helped other family members find work. Similarly, "Stress Tolerant Vegetable Cultivation" also received strong positive feedback, with 95.8% agreeing. CALOs like "Pig rearing" and "Green Job (Bamboo-based Handicraft)" also show high approval rates with 91.7% and 93.8% agreement respectively. In contrast, activities like "Duck rearing" and "Vermicompost" saw more neutral responses, indicating uncertainty or less noticeable impact on employment for family members. On the other end, "Sunflower cultivation", "Watermelon cultivation" and “Vermicompost” displayed considerable skepticism. For "Sunflower cultivation", 58.3% disagreed that it provided job opportunities for family members, and for “Vermicompost”, 24.1% disagreed with 20% agreeing and 55% being neutral. For "Watermelon cultivation", none of the participants agreed that it helped in creating employment.

Table 64: Respondent's perception on other family members been able to find more work due to CALO activities (Response in %, N=1011)

CALO Name	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Crab fattening	0	0	0	75	25
Carp fish polyculture	0	18.4	32.7	49	0
Sheep rearing	9.7	9.7	8.3	66.7	5.6
Pig rearing	0	0	0	91.7	8.3
Integrated Agriculture and Poultry	15.1	1.4	6.8	76.7	0
Duck and Fish farming	23.8	1.6	9.5	54	11.1
Integrated agriculture farming	4.1	12.4	3.1	79.4	1
Green Job (Bamboo-based Handicraft)	0	6.3	0	93.8	0
Duck rearing	6.3	14.6	54.2	25	0
Maize Cultivation	0	0	27.1	72.9	0
Integrated vegetable cultivation	0	3.2	47.6	42.9	6.3
Mung bean cultivation	0	0	66.7	33.3	0
Watermelon cultivation	0	41.7	58.3	0	0
Vermicompost	0	24.1	55.2	20.7	0
Saline water fisheries	0	0	20.8	79.2	0
Sheep and Duck rearing	6.1	10.2	12.2	71.4	0
Brackishwater Fish Polyculture	0	0	29.2	70.8	0
Stress Tolerant Vegetable (brinjal, rice,red-amaranth, cucumber .)	0	0	4.2	95.8	0
Sunflower cultivation	0	58.3	29.2	12.5	0
Native Poultry Rearing	0	0	29.2	70.8	0
Native Chicken Rearing	14	6.5	12.9	65.6	1.1
F-1 Calf Rearing	0	0	0	100	0
Total	5.5	8.1	20.3	63.6	2.5

In terms of agroecological zones, in the Active Tista Flood plain, there is a predominant positive sentiment, with 96.9% of respondents either agreeing or strongly agreeing that CALOs have helped in finding more work. This zone showed the highest support. In the Ganges Tidal Floodplain, the perception is moderately positive, with 64.2% agreeing or strongly agreeing, while 8.5% disagree or strongly disagree. The Young Meghna Estuarine Floodplain presents a unique scenario with 59.3% agreeing that CALOs create job opportunities, but a significant 19.1% strongly disagree. Conversely, the Sylhet Basin exhibits the most skepticism, with a total of 37.4% disagreeing or strongly disagreeing, and only 46.5% in agreement about the effectiveness of CALOs in creating additional employment opportunities for family members.

Table 65: Respondent's perception on other family members been able to find more work due to CALO activities by agro-ecological zones (Response in %, N=1011)

Agro-ecological zones	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Ganges Tidal Floodplain	0.2	8.3	27.3	60.4	3.8
Young Meghna Estuarine Floodplain	19.1	1.5	20.1	59.3	0
Active Tista Flood plain	0	0.6	2.4	93.3	3.6
Sylhet Basin	12	25.4	16.2	46.5	0
Total	5.5	8.1	20.3	63.6	2.5

5.2 Economic Impact on Women

The introduction of Climate Adaptive Livelihood Options (CALOs) has influenced the economic landscape for women, offering new pathways for income generation and financial empowerment. By providing tailored opportunities in diverse regions and sectors, CALOs have enabled women to improve their income streams substantially, reflecting the adaptability and resilience of women in leveraging these new avenues. Beyond income enhancement, CALOs have been instrumental in improving women's access to financial services, equipping them with the necessary financial literacy to manage resources effectively.

5.2.1 Income levels for women

Improved Income Streams

Women participating in CALOs have experienced varying degrees of income improvement, dependent on the type of activity and the region. CALOs allowing women to significantly boost their household income. This economic benefit is not only a testament to the success of CALOs in providing viable economic opportunities but also to the adaptability of women in capitalizing on these opportunities.

Access to Financial Resources

Alongside direct income improvements, CALOs have also improved women's access to financial resources. This access has been crucial in reducing financial vulnerability and enhancing women's ability to manage financial emergencies. The increased financial literacy and management skills gained through CALOs enable women to make more informed decisions regarding investments and savings, further stabilizing their economic conditions.

Challenges to Economic Empowerment

Despite the positive trends, challenges remain in consistently improving income levels across all regions and types of CALOs. In some areas, traditional norms and limited market access still pose barriers to maximizing economic benefits. These challenges underscore the need for targeted support and interventions to ensure that all women participating in CALOs can fully benefit from these initiatives.

5.2.2 Access to financial services

Enhancing Financial Inclusion

Climate Adaptive Livelihood Options (CALOs) have played a crucial role in enhancing women's access to financial services, which is fundamental to their economic empowerment. By integrating financial literacy programs and facilitating connections with financial institutions, CALOs have opened up avenues for women to engage more actively with the financial sector.

Improved Financial Literacy and Resources

One of the primary benefits of CALOs has been the improvement in financial literacy among women participants. These programs often include training on budget management, savings, and investment, which empower women to make informed financial decisions. Increased financial literacy not only boosts women's confidence in handling money but also improves their families' financial health.

Challenges in Access and Usage

Despite these advances, challenges persist in ensuring all women have equal access to these services. In some regions, cultural norms and skepticism about women's economic participation still hinder their full engagement with financial services. Additionally, the complexity of some financial products or the lack of tailored financial solutions that meet the unique needs of women can also limit effective utilization.

Sustainable Financial Practices

The continued focus of CALOs on improving access to and the use of financial services by women is crucial for sustainable development. As women become more economically empowered, they contribute not only to their households but also to the broader economic stability of their communities. Thus, enhancing financial inclusion through CALOs not only supports gender equality but also promotes resilient economic growth.

5.3 Social and Health Impact on Households

This below section explores the multifaceted aspects of food security, health improvements, safety, shelter, and adaptive capacity within the context of the LoGIC project's implementation of Climate Adaptive Livelihood Options (CALO) in Bangladesh. Utilizing the US Food Security Survey Module (FSSM), developed by the USDA, it assesses the prevalence and nature of food insecurity among diverse demographic groups, highlighting their ability to access adequate food for a healthy lifestyle. The report also delves into the progress made in healthcare accessibility in rural Bangladesh, underscoring significant advances in maternal and child health outcomes despite ongoing challenges related to infrastructure and professional shortages. Further, it examines how CALO has contributed to enhancing the economic stability and safety of households, thereby improving their resilience against natural disasters and climate-related shocks. By integrating sustainable agricultural practices and promoting collective action, CALO significantly bolsters the adaptive capacity of communities, enabling them to better respond to environmental challenges and climate change impacts. This document not only provides an analysis of current conditions but also offers insights into the potential for future interventions to enhance sustainability and resilience in vulnerable populations.

5.3.1 Food security

The US Food Security Survey Module (FSSM) is a comprehensive tool utilized to assess the food security status of households. Developed by the United States Department of Agriculture (USDA), the FSSM evaluates various aspects of food access and availability within households, including their ability to acquire enough food for an active, healthy lifestyle. It consists of a series of questions that gauge the frequency and severity of experiences related to insufficient food access, such as skipping meals or experiencing hunger due to financial constraints. This gives valuable insights into the prevalence and nature of food insecurity across different demographic groups.

Table 66: Percentage of respondents feels food security. (Response in %, N=1011)

Agro-ecological areas	Food secure	Food Insecure
Ganges Tidal Floodplain	48.9	51.1
Young Meghna Estuarine Floodplain	49.7	50.3
Active Tista Flood plain	98.8	1.2
Sylhet Basin	71.1	28.9

The results of the food security assessment conducted among LoGIC project beneficiaries practicing Climate Adaptive Livelihood Options (CALO) provide insights into the food security status within different agroecological zones of Bangladesh.

Since the beneficiaries started practicing CALO, in the Ganges Tidal Floodplain, approximately 48.90% of respondents reported feeling food secure, while 51.10% indicated food insecurity. This zone, characterized by its susceptibility to tidal floods, experiences a relatively high level of food insecurity, likely due to the challenges posed by frequent flooding on agricultural production and livelihoods. Similarly, in the Young Meghna Estuarine Floodplain, the distribution of food security is almost evenly split, with 49.70% of respondents reporting food security and 50.30% reporting food insecurity. This estuarine region, influenced by tidal dynamics and prone to flooding, faces similar food security challenges as the Ganges Tidal Floodplain.

Conversely, the Active Tista Floodplain exhibits a significantly higher level of food security, with 98.80% of respondents reporting feeling food secure and only 1.20% experiencing food insecurity. This zone, benefiting from the fertile lands and relatively stable water resources of the Tista River, enjoys a much more favorable food security situation compared to the tidal floodplains. In the Sylhet Basin, approximately 71.10% of respondents reported feeling food secure, while 28.90% indicated food insecurity. This basin, characterized by its diverse topography and agricultural practices, experiences moderate levels of food insecurity, likely influenced by factors such as soil erosion, land degradation, and water scarcity in certain areas. Also while discussing extensively with the CALO beneficiaries in all of the agro-ecological areas it was found that most of the respondents were happy the started practicing CALO and said that they have enough money for food and are able to afford balanced meals. During FGD with Beneficiaries in Rangamati Sadar one of the participants said:

> "Through specific CALO initiatives, we can strive to be profitable, meet the food demand of our families, and sell surplus crops in the market at fair prices. At the same time, if it can be sustainable and resilient as a livelihood, that's what I hope for."

Also, during FDG with beneficiaries in Kurigram one of the participants said

> "The economic situation has improved, and we have seen an increase in security. The food shortage has been alleviated."

Overall, these findings underscore the importance of considering the specific agroecological contexts and environmental factors when assessing food security within different regions of Bangladesh.

5.3.2 Health improvements

Accessibility of healthcare in rural Bangladesh presents a multifaceted challenge influenced by factors such as geographical barriers, limited infrastructure, and socioeconomic constraints. Remote villages often lack adequate healthcare facilities, forcing residents to travel long distances to access even basic medical services. Furthermore, transportation options are limited, exacerbating the difficulties of reaching healthcare providers. Additionally, the shortage of trained healthcare professionals in rural areas compounds the issue, resulting in long waiting times and substandard care. Despite facing significant these challenges, Bangladesh has made remarkable progress in enhancing the health outcomes of women and children. Over the past few decades, the maternal mortality rate has decreased by thirty-three percent, while child mortality has halved in the last ten years alone. This progress extends to improvements in life expectancy, increased immunization coverage, and successful efforts in controlling tuberculosis and diarrhea[1]. According to the annual progress report of 2022 till now 100,000 people from 35000 households have become climate resilient with access to health care, improved income and increased awareness for climate change adaptation. The below section will describe how climate adaptive livelihood options (CALO) under the LoGIC project have helped its beneficiaries to gain access to health care.

Table 67: Percentage of respondents able to access health care because of CALO. (Response in %, N=1011)

Agro-ecological areas	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Ganges Tidal Floodplain	0.2	6.5	34.7	58.2	0.4
Young Meghna Estuarine Floodplain	8.5	11.1	4.5	75.9	0.0
Active Tista Flood plain	0.0	0.6	6.1	89.7	3.6
Sylhet Basin	0.7	2.1	29.6	66.9	0.7
Total	1.9	5.8	23.3	68.1	0.9

The above table illustrates the percentage of respondents who reported accessing healthcare as a result of CALO across different agro-ecological areas. In the Ganges Tidal Floodplain, the majority (58.2%) agreed and 34.7% were neutral regarding the ability to access healthcare after they started practicing CALO, with only a small percentage expressing disagreement. Similarly, in the Active Tista Floodplain (89.7%) and Sylhet Basin (66.9%), the vast majority agreed that they are able to access healthcare. However, in the Young Meghna Estuarine Floodplain, while most respondents still agreed, there were notable percentages (8.9%) who disagreed or were neutral. Overall, the majority of respondents (68.1%) across all areas indicated that CALO positively contributed to their ability to access healthcare, highlighting its potential impact on healthcare accessibility in diverse agro-ecological contexts.

[1] https://idrc-crdi.ca/en/research-in-action/making-healthcare-accessible-bangladesh

5.3.3 Safety and shelter

LoGIC provided financial support (CRF) to 35,000 selected beneficiaries (99% women) who are implementing Climate Adaptive Livelihood Options (CALO) and 80% of beneficiaries (1st & 2nd Round) have gained positive economic benefits. The financial security gained through these initiatives will ensure that vulnerable households are cushioned against shocks and disasters. By diversifying income sources and enhancing economic stability, CALO enables households to better afford and maintain safer housing conditions, including improvements to infrastructure and resilience against natural disasters. Additionally, the economic benefits derived from CALO can contribute to building or repairing safer shelters, such as reinforced structures or relocating to less vulnerable areas. Moreover, improved access to healthcare resulting from CALO can lead to better health outcomes, reducing vulnerabilities and risks associated with illness or injury. By addressing economic and health-related vulnerabilities, CALO indirectly enhances beneficiaries' safety and shelter, contributing to overall resilience in the face of climatic challenges and disasters. Below section will highlight the perception of the beneficiaries regarding how much they feel safe and sheltered after they have started CALO.

Table 68: Percentage of respondents able to feel confident about their family's safety after starting CALO. (Response in %, N=1011)

Agro-ecological areas	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Ganges Tidal Floodplain	0.2	3.8	31.3	63.6	1.2
Young Meghna Estuarine Floodplain	4.0	14.6	4.5	76.4	0.5
Active Tista Flood plain	0.0	0.6	6.7	89.7	3.0
Sylhet Basin	0.0	2.8	9.9	85.2	2.1
Total	0.9	5.2	19.0	73.4	1.5

The above table presents the percentage of respondents who reported feeling confident about their family's safety following the implementation of CALO across different agro-ecological areas. In the Ganges Tidal Floodplain, a majority of respondents (63.6%) agreed that CALO had positively impacted their family's safety, with only a small percentage expressing disagreement. Similarly, in the Active Tista Floodplain and Sylhet Basin, the vast majority (89.7% an 85.2%) agreed about feeling confident regarding their family's safety due to CALO. However, in the Young Meghna Estuarine Floodplain, while most respondents still agreed, there were notable percentages who disagreed (14.6%). Overall, the majority of respondents (73.4%) across all areas indicated that CALO had positively contributed to their confidence in their family's safety. It was also found that CALO has secured social and community needs of the beneficiaries. One of the FGD participants in Patuakhali Said:

> "CALOs have significantly assisted us in meeting local demands by taking into account the relationship between livelihoods and food consumption. Through proactive CALO selection, they have supported us in fulfilling both social and economic needs."

Table 69: Percentage of respondent's condition of home improved since they have started CALO. (Response in %, N=1011)

Agro-ecological areas	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Ganges Tidal Floodplain	1.0	9.3	52.5	36.6	0.6
Young Meghna Estuarine Floodplain	18.6	1.5	17.1	61.8	1.0
Active Tista Flood plain	0.0	1.2	9.7	86.1	3.0
Sylhet Basin	0.0	2.8	41.5	54.9	0.7
Total	4.2	5.5	37.0	52.2	1.1

The above table depicts the percentage of respondents who reported improvements in the condition of their homes since the initiation of CALO, categorized by different agro-ecological areas. In the Ganges Tidal Floodplain, a notable proportion (52.5%) reported feeling neutral, while 36.6% agreed and 0.6% strongly agreed that their home conditions had improved due to CALO. In contrast, in the Young Meghna Estuarine Floodplain, a significant majority (61.8%) agreed and 1.0% strongly agreed about the improvement in their home conditions, although 18.6% expressed disagreement. Likewise, in the Active Tista Floodplain and Sylhet Basin, the majority of respondents agreed that their home conditions had improved since CALO implementation. However, overall, while a considerable proportion reported neutral feelings (37%), a significant majority (52.2%) across the regions acknowledged positive changes in their home conditions as a result of CALO. One of the FGD respondents in Sunamganj pointed out that.

"Economically, there has been progress. Previously, it was difficult to run the family only on the husband's income. Due to our income, suffering in the family is less."

Table 70: Percentage of respondents feel their home is safer and more protected from bad weather since CALO started. (Response in %, N=1011)

Agro-ecological areas	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Ganges Tidal Floodplain	0.8	9.5	44.4	44.4	1.0
Young Meghna Estuarine Floodplain	11.1	9.0	7.0	72.4	0.5
Active Tista Flood plain	0.0	0.6	6.1	90.3	3.0
Sylhet Basin	0.0	0.7	30.3	68.3	0.7
Total	2.6	6.7	128.8	60.7	1.2

The above table represents the percentage of respondents who perceive their homes to be safer and more protected from adverse weather conditions since the initiation of CALO, categorized by different agro-ecological areas. In the Ganges Tidal Floodplain, a significant portion (44.4%) of respondents agreed and an equal proportion felt neutral regarding the enhanced safety and protection of their homes due to CALO. Similarly, in the Active Tista Floodplain, the overwhelming majority (90.3%) agreed that their homes were safer and more protected, with 3.0% strongly agreeing. In the Young Meghna Estuarine Floodplain and Sylhet Basin, while the majority agreed (72.4% and 68.3%), there were notable percentages of respondents who disagreed (11.1%). Overall, the data indicates that across various agro-ecological areas, a considerable proportion of respondents perceive improvements in the safety and protection of their homes as a result of CALO, with differing levels of agreement across regions.

The overall findings suggest that the implementation of CALO (Climate Adaptive Livelihood Options) has had a positive impact on beneficiaries' safety, shelter conditions, and resilience to adverse weather conditions across different agro-ecological areas in Bangladesh. The majority of respondents reported feeling confident about their family's safety, with significant proportions acknowledging improvements in their home conditions and perceptions of increased safety and protection from bad weather. These results underscore the effectiveness of CALO in enhancing beneficiaries' resilience to climate-related challenges, highlighting its potential to contribute to sustainable livelihoods and improved living conditions in climate-vulnerable regions.

5.3.4 Adaptive Capacity

The combination of geographic positioning and socioeconomic factors has heightened the susceptibility of Bangladesh's population to the repercussions of climate change. Implementing efficient adaptation strategies could mitigate the negative consequences on livelihoods, health, agriculture, and the environment[1]. Diversifying income sources and promoting economic stability, CALO equips households with the financial resilience needed to withstand climate-related shocks and stresses. CALO initiatives incorporate sustainable agricultural practices and alternative livelihood options that are more resilient to changing climatic conditions, thereby reducing vulnerability to environmental hazards. Additionally, CALO programs frequently include capacity-building components that provide beneficiaries with knowledge and skills to better understand and respond to climate change impacts, empowering them to make informed decisions about adaptation measures. Furthermore, CALO initiatives often foster community cohesion and collective action, enabling communities to pool resources and collaborate on adaptation strategies, thereby strengthening overall adaptive capacity. Overall, CALO plays a crucial role in enhancing the resilience and adaptive capacity of beneficiaries to cope with the challenges posed by climate change. The below section will highlight the perception of the beneficiaries in different agro-ecological areas on how adaptive they have become towards climate change effects.

Table 71: Percentage of respondents feel they are more prepared for bad weather (like droughts or floods) after joining CALO. (Response in %, N=1011)

Agro-ecological areas	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Ganges Tidal Floodplain	1.4	82.8	14.5	1.2	0.2
Young Meghna Estuarine Floodplain	0.5	76.4	13.1	9.5	0.5
Active Tista Flood plain	1.8	79.4	12.7	4.8	1.2
Sylhet Basin	9.9	71.8	14.8	3.5	0.0
total	2.5	79.4	13.9	3.8	0.4

The above table presents the percentage of respondents who feel more prepared for adverse weather conditions, such as droughts or floods, after joining CALO, categorized by different agro-ecological areas. The major differences among the areas lie in the distribution of responses across the categories. In the Ganges Tidal Floodplain, the majority (82.8%) of respondents

disagreed that they felt more prepared, indicating a lack of perceived preparedness despite being in a flood-prone area. Conversely, in the Young Meghna Estuarine Floodplain, a significant proportion (76.4%) but a notable percentage (9.5%) agreed that they felt more prepared, suggesting a mixed response. Similarly, in the Active Tista Floodplain, while the majority (79.4%) disagreed, a small proportion (4.8%) agreed that they felt more prepared. the Sylhet Basin portrays the similar findings. Overall, the data highlights variations in perceived preparedness across different agro-ecological areas, with majority of the respondents disagreeing with the statement.

Table 72: Percentage of respondents said their income became more stable since they started CALO. (Response in %, N=1011)

Agro-ecological areas	Yes, much more stable	Yes, somewhat more stable	No change	Somewhat less stable	Much less stable
Ganges Tidal Floodplain	1.0	75.0	23.0	0.8	0.2
Young Meghna Estuarine Floodplain	0.0	76.9	8.0	13.6	1.5
Active Tista Flood plain	1.8	86.7	6.7	4.8	0.0
Sylhet Basin	2.8	54.2	42.3	0.7	0.0
total	1.2	74.4	20.1	4.0	0.4

The above table illustrates the percentage of respondents who reported changes in the stability of their income since initiating CALO (Climate Adaptive Livelihood Options), categorized by different agro-ecological areas. Across the regions, the majority of respondents (74.4%) indicated that their income became stable after starting CALO. In the Ganges Tidal Floodplain, 1.0% strongly felt their income became much more stable, and 75.0% reported somewhat more stability. Similarly, in the Young Meghna Estuarine Floodplain and the Active Tista Floodplain, a significant majority (76.9% and 86.7%, respectively) reported somewhat more stable incomes. In the Sylhet Basin, while the percentage reporting much more stability was slightly higher (2.8%), a smaller proportion (54.2%) reported somewhat more stability. Overall, the data indicates that CALO has had a positive impact on the stability of income for a substantial proportion of respondents across different agro-ecological areas, suggesting its effectiveness in promoting economic resilience. Also, during FGD with beneficiaries in Bandarban Rowangchhari one of the respondents said:

“As a result of involvement in CALO, there will be additional income for families, and women will be able to earn some money from staying home.”

Table 73: Percentage of respondents practice growing different types of pf crops or raising different animals' opinion on which is more relevant in the context of climate change. (Response in %, N=1011)

Agro-ecological areas	Yes, many new types	Yes, a few new types	No significant change	Tried but returned to previous types	No, not at all
Ganges Tidal Floodplain	3.60%	62.80%	18.80%	4.20%	10.70%
Young Meghna Estuarine Floodplain	0.00%	78.40%	5.00%	8.00%	8.50%
Active Tista Flood plain	3.00%	89.70%	6.10%	0.60%	0.60%
Sylhet Basin	2.10%	63.40%	33.80%	0.70%	0.00%
total	2.60%	70.30%	16.10%	3.90%	7.10%

The table shows that across various agro-ecological areas, most respondents have adopted new types of crops or animals to address climate change. In the Ganges Tidal Floodplain, 3.60% adopted many new types and 62.80% adopted a few, while in the Young Meghna Estuarine Floodplain and Active Tista Floodplain, 78.40% and 89.70% adopted a few, respectively. In the Sylhet Basin, 63.40% adopted a few and 2.10% many. Overall, the data indicates a widespread shift towards diversified agricultural practices, with respondents recognizing their relevance for coping with climate change.Regarding diversifying animal rearing on of the FGD participants in Sunamganj pointed out:

"We haven't faced much trouble with climate change, but due to six months of flooding in our area, duck farming has become suitable for us, and there is demand for duck eggs here."

Also, one of the FGD participants in Bagerhat said:

"The farming we do does not meet our needs; we don't spend much on food throughout the year. Nowadays, by raising cattle and goats, we are becoming somewhat self-reliant."

Table 74: Percentage of respondent's level of confidence on their household's adaptive capacity against climate change. (Response in %, N=1011)

Agro-ecological areas	Very confident	Confident	Neutral	Not very confident	Not confident at all
Ganges Tidal Floodplain	4.6	77.4	17.8	0.0	0.2
Young Meghna Estuarine Floodplain	0.0	76.9	4.5	17.1	1.5
Active Tista Flood plain	1.8	93.9	3.0	1.2	0.0
Sylhet Basin	7.0	83.8	8.5	0.7	0.0
total	3.6	80.9	11.5	3.7	0.4

The table shows that most respondents (80.9%) across various agro-ecological areas are confident in their household's adaptive capacity to climate change. Confidence levels vary, with 93.90% in the Active Tista Floodplain and 83.80% in the Sylhet Basin expressing confidence, while a smaller percentage in the Young Meghna Estuarine Floodplain (76.90%) and Ganges Tidal Floodplain (77.40%) also feel confident. Overall, the data reflects a generally positive perception of adaptive capacity.This finding is similar to what one of the FGD participants in Barguna said:

“As part of the CALO program, the risk of climate change has decreased significantly in many aspects because crop production has increased due to the selection of CALO, and efforts are underway to mitigate risks.”

The findings reveal a strong adaptive capacity among respondents in Bangladesh's agro-ecological areas, with most feeling better prepared for adverse weather since joining Climate Adaptive Livelihood Options (CALO). The adoption of new agricultural practices and improvements in income stability and household resilience highlight the proactive approach of CALO initiatives. High confidence levels in adaptive capacity further underscore the effectiveness of CALO programs in enhancing resilience and promoting sustainable livelihoods across diverse contexts.

5.4 Gender Roles and Empowerment

The implementation of Climate Adaptive Livelihood Options (CALOs) has significantly advanced gender roles and empowerment by expanding economic opportunities for women and fostering cultural shifts within communities. By involving women in traditionally male-dominated sectors and enhancing their roles in decision-making and leadership, CALOs have helped break down traditional gender barriers, showcasing both progressive changes and ongoing challenges in achieving gender equality.

5.4.1 Women's participation in CALOs

Advancements in Participation

Women's involvement in Climate Adaptive Livelihood Options (CALOs) has led to increased empowerment and active participation in leadership and decision-making roles, including union councils and government offices, thereby enhancing their influence in both family and economic spheres.

Economic Opportunities

Women engaged in CALOs have seen increased income and improved access to financial resources, enhancing their economic independence and reducing financial vulnerability.

Social and Cultural Shifts

Participation in CALOs has improved community perception and trust in women, breaking barriers and fostering respect for their opinions, leading to increased involvement in decision-making and a more inclusive environment.

Challenges

Despite advancements, cultural and structural challenges persist, limiting women's full potential in CALOs due to traditional norms and societal expectations, requiring ongoing efforts to promote gender equality.

5.4.2 Changes in gender roles

Introduction to Shifts in Gender Roles

Women's participation in CALOs has driven shifts in traditional gender roles, leading to increased economic involvement, leadership roles, and equitable household responsibilities, contributing to a broader cultural shift towards gender equality.

Economic Empowerment

Economically, CALOs have enabled women to access new livelihood opportunities, which were traditionally dominated by men. This economic empowerment is evident from women improved financial resources and enhanced ability to contribute to household income.

[1] https://www.sciencedirect.com/science/article/pii/S266727822100105X

Leadership and Decision-Making

Women's roles have expanded into community and economic leadership through CALOs, enhancing their visibility and influence in decision-making and increasing community respect and trust in their capabilities. Household Dynamics

CALOs have significantly redistributed household chores more equitably between men and women, challenging traditional norms and promoting shared responsibilities and changing attitudes towards domestic tasks.

Cultural Shifts

These shifts in economic roles, leadership, and household dynamics reflect a cultural transition towards gender equality, as communities increasingly recognize and value women's contributions, leading to more egalitarian societal norms.

Challenges and Opportunities

Despite progress, deep-rooted cultural norms and resistance to change can hinder gender equality, but continued advocacy, education, and policy support are crucial for sustaining and expanding the gains achieved through CALOs.

Chapter 6
A context specific list of CALOs

6.1 Ranked list of existing CALOs

To identify the most promising CALOs for long-term success, we conducted a comprehensive ranking process that evaluated viability, adaptability, and marketability to create a single, integrated ranking reflecting each CALO's overall potential.

Table 75: *Ranked list of existing CALOs*

CALO	Viability Score	Adaptability Score	Marketability Score	Viability Norm	Adaptability Norm	Marketability Norm	Final Score
Watermelon cultivation	80.6	100.00	47.2	100.0	100.0	66.3	88.8
F-1 Calf Rearing	80.4	91.25	50.8	99.8	91.3	78.7	89.9
Stress Tolerant Vegetable	69.8	98.87	49.6	86.6	98.9	75.5	87.0
Mung Bean cultivation	80.6	86.67	51.5	100.0	86.7	80.6	89.1
Maize Cultivation	77.4	85.42	49.3	96.0	85.4	74.6	85.3
Integrated Agriculture Farming	79.0	91.65	48.8	98.0	91.7	73.6	87.8
Integrated Vegetable Cultivation	79.0	90.95	48.7	98.0	91.0	73.4	87.5
Brackish Water Fish Polyculture	78.2	92.71	48.4	97.0	92.7	72.7	87.5
Green Job (Bamboo-based Handicraft)	74.2	98.13	48.1	92.0	98.1	72.0	87.4
Crab Fattening	78.2	99.58	45.2	97.0	99.6	65.8	87.5
Vermicompost	74.4	96.90	46.2	92.3	96.9	68.2	85.8
Duck rearing	76.4	86.67	48.2	94.8	86.7	71.7	84.4
Saline water fisheries	73.2	97.92	46.5	90.9	97.9	68.9	85.9
Native Poultry Rearing	74.6	86.67	47.3	92.5	86.7	66.5	81.9
Integrated Agriculture and Poultry	71.8	73.42	47.2	89.0	73.4	66.3	76.2
Sheep rearing	80.8	84.88	47.2	100.2	84.9	66.3	83.8
Sheep and Duck rearing	72.0	93.27	46.6	89.3	93.3	69.2	83.9
Native Chicken Rearing	76.4	83.01	46.3	94.8	83.0	68.4	82.1
Duck & Fish Farming	72.6	69.84	46.1	90.1	69.8	67.7	75.9
Carp fish polyculture	74.4	76.12	42.8	92.3	76.1	60.1	76.2
Pig rearing	80.2	79.45	41.0	99.5	79.5	55.4	78.1
Sunflower cultivation	70.6	14.17	33.4	87.6	14.2	38.8	46.9

The ranked list evaluates various CALOs based on Viability, Adaptability, and Marketability scores, normalized to a common scale for fair comparison, and includes a discussion of the findings and their implications.Here's a brief discussion of the findings and the implications of the scores:

Top Performers

Watermelon Cultivation: With a final score of 88.8, watermelon cultivation emerges as one of the most promising CALOs. This high score reflects its excellent adaptability to climatic stressors, robust viability across various capitals, and strong marketability.

F-1 Calf Rearing: Scoring 89.9, F-1 calf rearing demonstrates a balanced strength in adaptability, viability, and marketability. Its high adaptability score indicates it can withstand environmental challenges, while its marketability score shows economic potential.

Mung Bean Cultivation: With a score of 89.1, mung bean cultivation is another top performer. Its strong performance across all three analyses highlights its potential as a resilient and profitable livelihood option.

Crab Fattening: Scoring 87.5, crab fattening stands out due to its exceptional adaptability and reasonable marketability, making it a viable option in coastal regions facing salinity intrusion.

Moderate Performers

Stress Tolerant Vegetable Cultivation: With a score of 87.0, this CALO shows significant promise due to its high adaptability and good marketability.

Integrated Agriculture Farming: Scoring 87.8, this option reflects balanced performance across viability, adaptability, and marketability, indicating its potential for sustainable practice.

Brackish Water Fish Polyculture and Integrated Vegetable Cultivation: Both scoring 87.5, these options show strong potential due to their high adaptability and reasonable marketability.

Lower Performers

Duck & Fish Farming and Pig Rearing: With scores of 75.9 and 78.1 respectively, these CALOs indicate room for improvement, particularly in marketability and adaptability.

Sunflower Cultivation: With a score of 46.9, sunflower cultivation is the least promising CALO. Its low adaptability score significantly drags down its overall potential, indicating substantial challenges in coping with climatic stressors.

Implications

High-scoring CALOs like watermelon cultivation and F-1 calf rearing should be prioritized for support due to their strong potential for success and sustainability. Moderate-scoring options, such as integrated agriculture farming, may need targeted interventions to improve marketability or adaptability. Low-scoring CALOs, like sunflower cultivation, face significant challenges and require substantial improvement or reconsideration before they can be deemed viable.

6.2 Agro-ecological zone wise proposed list of CALOs

The chapter examines alternative CALOs for Bangladesh's diverse agro-ecological regions, including the Active Tista Floodplain and Sylhet Basin, designed to enhance resilience and sustainability by combining traditional knowledge with modern practices. These CALOs address regional challenges like flooding and soil salinity, offering improved social acceptance, economic viability, and environmental sustainability, and ensuring that communities can achieve sustainable livelihoods and long-term environmental stewardship.

Table 76: *List of alternative CALO for each of the Agro-economical areas*

Agro-ecological areas	Alternative CALOs	Social viabilities	Economical viabilities	Environmental viabilities
Active Tista Floodplain	**Flood-resistant rice varieties** Example: BRRI dhan 51, BRRI dhan 52, BRRI dhan 79, BINA Dhan 11 and Bina Dhan 12	High acceptance among local farmers due to familiarity with rice cultivation	Potential for high economic returns as rice is a staple crop.	Can survive submergence, reducing crop loss during floods.
	Floating gardens (Hydroponics)	Moderate acceptance; requires training and community engagement.	High economic potential through year-round vegetable production.	Utilizes floodwaters for cultivation, reducing land dependency and improving water management.
	Duck-Fish Farming	High acceptance; integrates well with existing farming practices.	Dual-income source from both ducks and fish.	Ducks control pests and fertilize fish-ponds, promoting a balanced ecosystem.
Sylhet Basin	**Boro rice varieties resistant to flash floods** Example: BRRI dhan 28, BRRI dhan 29 and BRRI dhan 45	High acceptance due to existing familiarity with boro rice.	High potential economic returns.	Specially bred to withstand flash floods, reducing crop losses.
	Haor-based fisheries	High acceptance; aligns with traditional fishing practices.	High potential through sustainable fish farming.	Suitable for the wetland ecosystem, enhancing biodiversity.
	Short-duration pulse cultivation (Lentils, Mung Beans)	Moderate acceptance; requires awareness and training	High economic potential with short crop cycles.	Pulses improve soil fertility through nitrogen fixation.
Ganges Tidal Floodplain	**Salt-Tolerant rice varieties** Example: BRRI dhan 47, BRRI dhan 53, BRRI dhan 54, BRRI dhan 55, and BRRI dhan 61; BINA dhan 8 and 10.	High acceptance; builds on existing rice farming knowledge.	High returns due to stable market demand for rice.	Specifically bred for saline conditions, improving resilience.
	Brackishwater shrimp and fish farming Example: Poa fish, Milk fish, Vangal fish, Vetki fish, Tiger prawn.	High acceptance; traditional practice in coastal areas.	High potential income through export markets.	Utilizes blocked saline water in the low lying pockets, reducing the impact on freshwater resources.
	Mangrove afforestation and sustainable harvesting	Moderate acceptance; requires community involvement.	High potential through sustainable timber and non-timber products.	Enhances coastal protection against tidal surges, improving biodiversity.

	Crop rotation technology	Farmers are often familiar with different crops, making it easier to adopt crop rotation practices.	Diverse crops can tap into different market demands, providing farmers with multiple income streams and reducing dependency on a single crop.	Increased diversity of crops leads to greater agrobiodiversity, promoting a more resilient ecosystem.
	Rainwater harvesting and integrated water management	Improved access to clean water reduces waterborne diseases, enhancing community health and well-being.	Harvesting rainwater reduces dependence on expensive or unreliable external water sources, lowering household and agricultural costs.	Rainwater harvesting promotes the sustainable use of local water resources, reducing pressure on groundwater and surface water supplies.
	Super Hybrid Napier Grass-Pakchong cultivation	Reliable source of fodder for livestock, Knowledge Transfer and Training	High Yield and Profitability, There is a strong market demand for fodder, means of income diversification	Napier Grass has a robust root system that helps in soil conservation, ability to tolerate various water conditions, Introducing Napier Grass into the farming system can enhance biodiversity
Young Meghna Estuarine Floodplain	**Salt-tolerant rice varieties** Example:BRRI dhan 47, BRRI dhan 53, BRRI dhan 54, BRRI dhan 55, and BRRI dhan 61; BINA dhan 8 and 10.	High acceptance; builds on existing rice farming knowledge.	High returns due to stable market demand for rice.	Specifically bred for saline conditions, improving resilience.
	Brackish water shrimp and fish farming Example: Poa fish, Milk fish, Vangal fish, Vetki fish, Tiger prawn,	High acceptance; traditional practice in coastal areas.	High potential income through export markets.	Utilizes saline water, reducing the impact on freshwater resources.
	Aquaculture and horticulture integration Example: Tomatoes, Papaya, Watermelon	High acceptance due to the integration of familiar practices.	High potential returns from diversified income sources.	Enhances water use efficiency and supports biodiversity.
	Rainwater harvesting and integrated water management	Improved access to clean water reduces waterborne diseases, enhancing community health and well-being.	Harvesting rainwater reduces dependence on expensive or unreliable external water sources, lowering household and agricultural costs.	Rainwater harvesting promotes the sustainable use of local water resources, reducing pressure on groundwater and surface water supplies.

Northern and Eastern Hills	**Agroforestry (Tree-crop-livestock integration)**	High acceptance; aligns with traditional practices.	Diversifies income through multiple products.	Reduces soil erosion and enhances biodiversity.
	Silvopasture (combining forestry with grazing)	High acceptance among livestock farmers.	Diversified income from timber and livestock.	Enhances soil health and provides fodder.
	Eco-tourism	Development of eco-tourism often leads to improved local infrastructure such as roads, health centers, and schools.	Provides a sustainable source of revenue that can support community development projects and improve living standards.	Forest conservation and reforestation efforts associated with eco-tourism contribute to carbon sequestration, helping mitigate climate change.
	Waste-recycling	Clean and well-managed environments enhance the overall quality of life for residents.	Adds a new economic activity to the region, reducing dependency on traditional livelihoods such as agriculture.	Diverting waste from landfills reduces land, air, and water pollution, protecting local ecosystems.
	Fruit Processing Industry	Empowerment and Skill Development, Enhanced Livelihoods for Farmers, contribute to community development by creating job opportunities	Adds value to raw agricultural produce, leading to higher profitability, growing demand for processed fruit products both domestically and internationally, infrastructure development, farmers can diversify their income sources, reducing their dependence on raw fruit sales	Reduction in Post-Harvest Losses, can incentivize sustainable farming practices, Fruit waste and by-products can be converted into useful products like animal feed, compost, or bioenergy, Promotion of Agroforestry

Chapter 7
Recommendations

CALO Wise recommendations

1. Brackishwater Fish Polyculture

To enhance Brackishwater Fish Polyculture, recommendations include improving environmental management through regular water quality monitoring, developing tailored financial mechanisms like microloans and insurance, and increasing community engagement by forming a management committee. Training sessions on best aquaculture practices and promoting biodiversity-friendly practices are also essential. These measures aim to ensure optimal water quality, better financial support, active community involvement, improved farming techniques, and enhanced biodiversity within specified timeframes.

2. Carp Polyculture

To enhance Carp Polyculture, recommendations include improving environmental sustainability with better waste management and water quality control, providing financial support through low-interest loans and savings schemes, increasing market access by establishing cooperative societies, and boosting community engagement through advisory groups and incentives. Additionally, regular training sessions on advanced farming techniques are essential. These measures aim to ensure optimal water quality, economic stability, effective market access, and enhanced skills among farmers.

3. Crab Fattening

To boost Crab Fattening's effectiveness and sustainability, recommendations include improving environmental management through regular water quality checks, enhancing human health services with quarterly health and safety training, and increasing community engagement via monthly meetings and incentives. Additionally, bi-monthly training sessions on best practices and disease management are essential, along with developing financial mechanisms like microloans and insurance products, supported by financial literacy workshops. These measures aim to optimize crab health, worker well-being, community involvement, and financial stability.

4. Duck & Fish Farming

To enhance Duck & Fish Farming, recommendations include improving water quality with integrated management systems and biofilters to meet optimal standards for 85% of water samples within a year. Farmers should diversify income by integrating activities like aquaponics, with 50% adoption targeted in two years. Establishing community groups for knowledge sharing and problem-solving, and organizing bi-monthly training sessions, will support productivity and sustainability. Financial stability can be bolstered by developing microloans and insurance products, ensuring 70% of farmers have access to these resources within a year, supported by financial literacy workshops.

5. Duck Rearing

To enhance Duck Rearing, recommendations include improving water management with ponds and rainwater harvesting to ensure 80% of operations have adequate water within a year. Regular

health check-ups and disease management should be implemented to reduce outbreaks by 50% within two years. Bi-monthly training sessions on best practices and financial products like microloans should support economic stability, with 70% of farmers targeted to access these within a year. Establishing community groups for knowledge sharing and encouraging income diversification through complementary activities can further boost resilience and involvement, aiming for 50% diversification within two years.

6. F-1 Calf Rearing

To enhance F-1 Calf Rearing, key recommendations include organizing bi-monthly training sessions on best practices and partnering with local vets to reduce calf mortality by 50% within two years. Developing financial products like microloans and insurance, with 70% of farmers targeted for access within a year, and improving calf housing facilities for 60% of rearers within two years are also crucial. Establishing community groups for knowledge sharing and boosting market access through cooperatives can further support economic stability and efficiency.

7. Green Job (Bamboo-based Handicraft)

To boost the effectiveness and sustainability of bamboo-based handicrafts, key recommendations include training 80% of artisans in sustainable harvesting, diversifying product lines for 60% of artisans, and improving market access by connecting 70% of artisans to better opportunities through cooperatives and e-commerce. Additionally, developing financial products and providing support for 70% of artisans, organizing quarterly workshops on design and business management, and establishing community groups with a 90% participation rate are essential. Promoting biodiversity-friendly practices in 50% of operations within a year will further enhance environmental sustainability.

8. Integrated Agriculture and Poultry

To improve the effectiveness and sustainability of Integrated Agriculture and Poultry systems, key recommendations include forming local advisory groups with a 90% farmer participation rate, developing tailored financial products for 70% of farmers, and organizing bi-monthly training sessions with at least 75% attendance. Enhancing market access through cooperatives, promoting sustainable practices in 50% of operations, and upgrading infrastructure for 60% of farmers are also essential. Providing incentives, financial support, and technical assistance will further support these initiatives.

9. Integrated Agriculture Farming

To boost the effectiveness and sustainability of Integrated Agriculture Farming, recommendations include organizing bi-monthly educational workshops covering diverse farming practices, promoting sustainable methods with technical support and subsidies, and forming local farmer groups for collective problem-solving. Tailored financial products and infrastructure improvements are crucial, aiming to support 70% of farmers and upgrade 60% of facilities within a year. Additionally, adopting biodiversity-friendly practices and enhancing market access through cooperatives will further improve farm productivity and economic returns.

10. Integrated Vegetable Cultivation

To enhance the effectiveness and sustainability of Integrated Vegetable Cultivation, key recommendations include organizing bi-monthly workshops on advanced cultivation techniques, developing tailored financial products like microloans, and forming local farmer cooperatives to boost knowledge sharing. Sustainable practices such as organic farming and efficient irrigation should be promoted, with a target of implementing these in 50% of farms within a year. Infrastructure improvements, including better storage and irrigation facilities, are essential, with a

goal of upgrading 60% of farms within two years. Additionally, enhancing market access through cooperatives and ensuring adherence to health and safety standards can improve productivity and economic returns.

11. Maize Cultivation

To enhance maize cultivation, practical recommendations include implementing soil conservation techniques, such as contour farming and cover crops, through bi-monthly training workshops; diversifying income with complementary activities like livestock rearing; and developing tailored financial products like microloans. Establishing local farmer cooperatives for knowledge sharing, improving infrastructure for storage and irrigation, and enhancing market access are also critical. Regular training on advanced cultivation practices and collaboration with agricultural experts and NGOs can significantly boost productivity and sustainability.

12. Mung Bean Cultivation

To enhance mung bean cultivation, focus on effective salinity management through bi-monthly workshops on techniques like gypsum application and irrigation, aiming for 75% farmer attendance. Develop tailored financial products such as microloans and insurance, and ensure 70% farmer access within a year, complemented by financial literacy workshops. Establish local farmer cooperatives to share knowledge and solve problems, with a 90% participation goal. Promote sustainable practices like crop rotation and organic farming, targeting 50% adoption within a year. Improve infrastructure for storage and irrigation, with a goal to upgrade 60% of facilities in two years. Regular training on advanced techniques and improved seed varieties should also be organized bi-monthly, ensuring effective outcomes through collaboration with experts and NGOs.

13. Native Chicken Rearing

To boost the effectiveness and sustainability of native chicken rearing, focus on improving waste management and water supply with bi-monthly training sessions, targeting 80% adoption within a year. Implement regular health check-ups and disease management, aiming for a 50% reduction in outbreaks within two years through quarterly health camps and training. Conduct bi-monthly workshops on best practices, with a goal of 75% farmer attendance. Develop financial products like microloans and insurance, ensuring 70% access within a year, and offer financial literacy workshops. Promote sustainable practices such as organic feed and free-range rearing, targeting 50% adoption within a year. Invest in better housing for chickens, aiming to upgrade 60% of facilities within two years, supported by local government and NGOs.

14. Native Poultry Rearing

To enhance the effectiveness and sustainability of native poultry rearing, implement efficient waste management and ensure clean water supply through bi-monthly training, aiming for 80% adoption within a year. Develop financial products like microloans and insurance, ensuring 70%

access within one year, and provide accompanying financial literacy workshops. Encourage sustainable practices such as organic feed and free-range rearing, targeting 50% adoption within a year. Organize quarterly health check-ups and training to reduce disease outbreaks by 50% within two years. Invest in infrastructure improvements for better poultry housing, aiming to upgrade 60% of facilities within two years, supported by local government and NGOs.

15. Pig Rearing

To improve pig rearing, focus on sustainable grazing by training farmers on rotational grazing and fodder crops, with bi-monthly workshops achieving 75% attendance. Develop financial products like microloans and insurance, ensuring 70% access within a year, accompanied by financial

literacy workshops. Organize quarterly health camps to reduce disease outbreaks by 50% within two years. Enhance market access through cooperatives, aiming to form five within six months. Upgrade housing facilities for 60% of pig rearers within two years, supported by local government and NGOs, to improve health and growth rates.

16. Saline Water Fisheries

To enhance saline water fisheries, organize bi-monthly training sessions for fish farmers on best practices, aiming for 75% attendance, with support from aquaculture experts and NGOs. Develop tailored financial products like microloans and insurance, ensuring 70% access within a year, along with financial literacy workshops. Establish community groups or cooperatives to foster knowledge sharing and problem-solving, targeting 90% participation. Promote sustainable practices such as polyculture and IMTA, with a goal of 50% adoption within a year, and invest in infrastructure improvements like pond management and storage, upgrading 60% of facilities within two years. Enhance market access by forming five cooperatives within six months and ensure worker and fish health through regular check-ups and disease management, aiming to reduce outbreaks by 50% in two years.

17. Sheep and Duck Rearing

To improve sheep and duck rearing, implement quarterly health camps and disease management programs to reduce outbreaks by 50% within two years, with support from local veterinary services and NGOs. Develop microloans and insurance schemes with local banks to ensure 70% of farmers have financial support within a year, complemented by financial literacy workshops. Encourage sustainable practices like rotational grazing and integrated pest management, aiming for 50% adoption within a year, and invest in infrastructure improvements, such as better housing, to upgrade 60% of facilities within two years. Form at least five cooperatives within six months to enhance market access and negotiate better prices for products.

18. Sheep Rearing

To enhance sheep rearing, implement bi-monthly workshops on techniques like nutrition, breeding, and disease management to ensure 75% farmer attendance, with support from agricultural experts and universities. Organize quarterly health camps to reduce disease outbreaks by 50% within two years, with assistance from local veterinary services and NGOs. Develop microloans and insurance schemes with local banks to provide financial support to 70% of farmers within a year, alongside financial literacy workshops. Upgrade housing facilities for at least 60% of farmers within two years to improve health and growth, and form at least five cooperatives within six months to boost market access and negotiate better prices, with support from agricultural marketing organizations.

19. Stress Tolerant Vegetable Cultivation

To improve stress-tolerant vegetable cultivation, organize bi-monthly workshops on advanced techniques like stress-tolerant varieties and soil health, ensuring 75% farmer attendance, with support from agricultural experts and NGOs. Develop microloans and insurance products with local banks to support 70% of farmers within a year, complemented by financial literacy workshops. Upgrade infrastructure, such as storage and irrigation, for 60% of farms within two years, and enhance market access by forming at least five cooperatives within six months. Ensure 80% of farmers access high-quality seeds and inputs within one year by establishing reliable supply chains and partnerships.

20. Watermelon Cultivation

To enhance watermelon cultivation, improve financial literacy and market access by organizing

regular workshops and developing tailored financial products, ensuring 70% of farmers have access to support within a year. Form at least five cooperatives within six months to help with collective marketing. Promote sustainable practices like organic fertilizers and efficient irrigation, aiming for 50% adoption within one year, and upgrade storage and irrigation facilities for 60% of farms within two years. Ensure 80% of farmers have access to high-quality inputs and implement efficient water management practices in 50% of farms within one year. Partner with local banks, NGOs, and agricultural suppliers to support these initiatives.

21. Sunflower Cultivation

To improve sunflower cultivation, focus on enhancing financial literacy through regular workshops and tailored financial products, ensuring 70% of farmers receive support within a year. Form at least five cooperatives within six months to aid in collective marketing. Promote sustainable practices like organic fertilizers and efficient irrigation, aiming for 50% adoption within one year. Upgrade storage and irrigation facilities for 60% of farms within two years, and provide access to high-quality seeds and inputs, targeting 80% coverage within a year. Implement efficient water management practices in 50% of farms within one year, supported by technical assistance and subsidies.

22. Vermicompost

To enhance vermicompost production, regularly train farmers on techniques such as waste segregation and worm management through bi-monthly workshops, ensuring 75% attendance. Develop tailored financial products and financial literacy programs, aiming for 70% producer access within a year. Establish local cooperatives to boost knowledge sharing and achieve 90% participation. Promote sustainable practices and provide technical support to reach 50% adoption within a year. Upgrade infrastructure for 60% of units within two years and improve market access by forming at least five cooperatives within six months. Ensure 80% of producers access high-quality inputs within a year and focus on health and safety to reduce work-related issues by 50% within two years.

Strategic Recommendations

To enhance environmental sustainability and address challenges such as soil salinity and biodiversity loss, implement advanced soil and water conservation techniques and conduct regular environmental assessments to adapt CALOs to changing climatic conditions. Advocate for policies that improve access to financial services and incentivize sustainable practices while strengthening governance for equitable resource distribution and transparency. Engage in policy advocacy to support climate-resilient practices and streamline regulatory processes. Encourage economic diversification through value-added products, agri-tourism, and alternative markets to reduce vulnerability. Establish robust collaborative frameworks among local governments, civil society, and international partners for unified climate resilience efforts. Scale up successful CALOs using data-driven approaches, and develop long-term sustainability plans, including technical support and financial strategies. Enhance agro-ecological zoning, invest in resilient agricultural techniques, and expand financial services and healthcare access, particularly for women and remote areas, to ensure broader impact and sustainability.

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Annex

Analysis approach: The Sustainable Livelihoods framework
Scoring and Weighting

Score: based on access and/or ownership of livelihoods assets.

0: no access

3: enough access/amount to develop the livelihoods activity and improve it.

Weight: based on importance of the asset (according to community/livelihoods group).

Put weight to "0" in rows that are not measured

Change of scoring range

If you want, you can change the range of values (for scoring and weighting) If you change it. It should be necessary to change the value of "score max value" to the new one (cell in grey color)

Insert a new row

To insert a new row, do it in the middle, to be sure that the formula will include it. (For instance, to insert a row into "physical capital" do the insertion between rows 11-12.). Then copy and paste the "Total Score" formula.

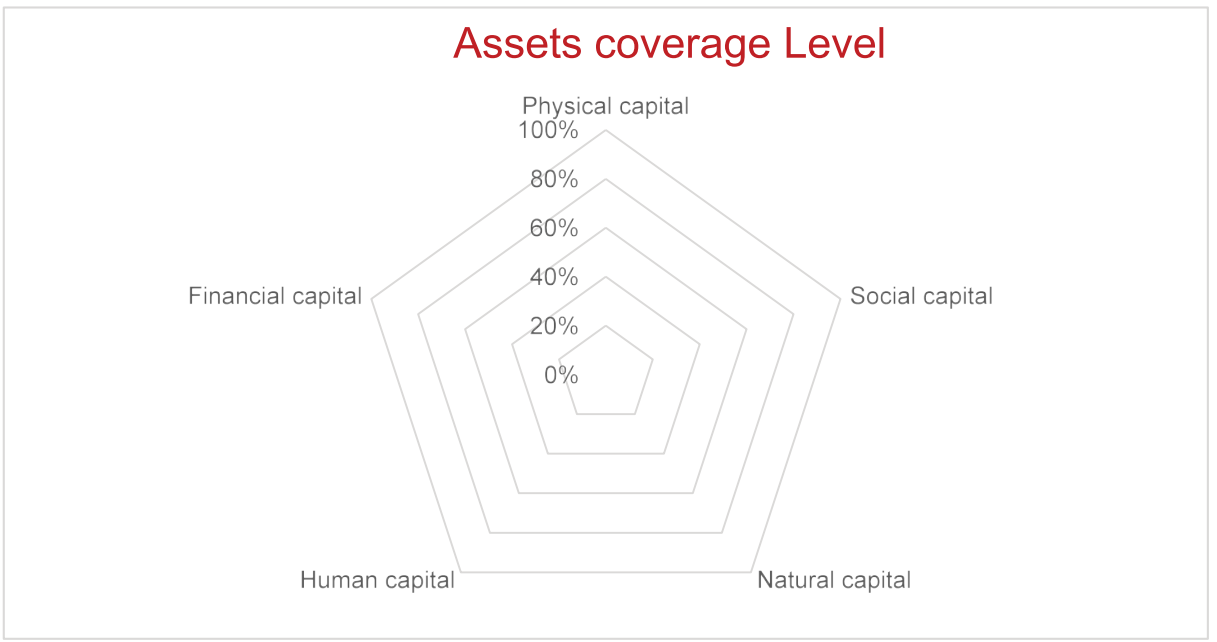
Livelihood Capitals Analysis Diagram. Coverage Level/GAP Level

Coverage: Total score/ Max. Total Score

Max. Total Score: Assets weight addition * Score max. value

Score max value 3

Livelihood Assets Coverage Level



Food Security Index

The assessment of food security and food insecurity among the CRF beneficiaries involved utilizing a modified version of the U.S. Household Food Security Survey Module, specifically the six-item short form. This approach measures the frequency and severity of food insecurity experiences within households. Participants responded to a series of questions regarding their ability to afford sufficient and balanced meals, and instances of reducing meal sizes or skipping meals due to financial constraints. Affirmative responses to questions like whether purchased food lasted, whether balanced meals were affordable, and whether meals were skipped or reduced, were used to calculate a raw score which directly corresponds to different levels of food security.

The raw score, derived from the sum of affirmative responses, categorizes households into three levels: high or marginal food security (scores 0-1), low food security (scores 2-4), and very low food security (scores 5-6). This scoring system allows researchers to clearly distinguish between food-secure and food-insecure households. For example, a household scoring between two and four is categorized as having low food security, indicating some problems or limitations in accessing adequate food. For The reporting purposes, the food security status of households with raw score 0-1 is described as food secure and the two categories “low food security” and “very low food security” in combination are referred to as food insecure.

Preparation of ranked list of existing CALOs

1. Viability, Adaptability and Marketability Analysis

Viability Analysis: This analysis evaluates the performance of each CALO across five key capitals (Physical, Social, Natural, Human, and Financial) using the Sustainable Livelihood Framework. Each CALO was scored on a scale of 0 to 100 based on its performance in each capital. The average score for each CALO was then calculated to provide an overall viability score.

Adaptability Analysis: This analysis assesses the resilience of each CALO to climatic stressors such as extreme temperatures, drought, changes in rainfall patterns, salinity intrusion, cyclones, floods, pest outbreaks, and shifts in growing or harvesting seasons. Respondents practicing each CALO provided feedback on its adaptability, and the responses were converted into scores on a scale of 0 to 100.

Marketability Analysis: This analysis evaluates the market potential of each CALO based on respondents' experiences and perceptions. The marketability score was derived from a set of 13 items on a Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The raw scores were then normalized to a scale of 13 to 65 and categorized into Low, Medium, and High marketability.

2. Normalization of Scores

Viability and Adaptability Scores: These scores were already on a common scale of 0 to 100. Therefore, no further normalization was required for these two analyses.

Marketability Scores: The marketability scores were normalized using the formula:

$$\text{Marketability Norm} = \{(\text{Marketability Score} - 13)/65 - 13\} \times 100$$

3. Combining the Scores

Once all scores were normalized to a common scale, we combined them to calculate a final score for each CALO. Each of the three analyses (Viability, Adaptability, and Marketability) was given equal weight in this combined score.

The formula used to calculate the final score for each CALO was:
Final Score= (Viability Norm Adaptability Norm Marketability Norm)/3

4. Ranking the CALOs

The final scores for each CALO were sorted in descending order to produce a ranked list from the most promising CALO to the least promising one. This ranking reflects the overall potential of each CALO, considering its viability, adaptability, and marketability.