USDA Food for Progress Bangladesh Project

BASELINE STUDY REPORT

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Baseline Study for the USDA Food for Progress Bangladesh Project

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ABBREVIATIONS

AI	Artificial Insemination
ACDI/VOCA	Agriculture Cooperative Development International/Volunteers Overseas Cooperation Assistance
AH	Animal Health
BARC	Bangladesh Agricultural Research Council
BBS	Bangladesh Bureau of Statistics
BCSL	Bangladesh Climate Smart Livestock
BDS	Business Develop Service
BLRI	Bangladesh Livestock Research Institute
BDT	Bangladeshi Taka
C	A Coefficient
C_a	Activity coefficient
CAHW	Community-based Animal Health Workers
CDIL	Central Disease Investigation Laboratory
CH_4	Methane
CLA	Collaboration, Learning and Adapting
CNRS	Center For Natural Resource Studies
Cf_i	Maintenance coefficient [unit MJ/day/kg]
CO_2	Carbon dioxide
CO_2E	Carbon dioxide Equivalents
CSA	Climate Smart Agriculture
CSL	Climate-Smart Livestock
DAE	Department of Agricultural Extension
DoE	Department of Environment
DLS	Department of Livestock Services
DMI	Dry Matter Intake
EPA	Environmental Protection Agency
FAO	Food and Agriculture Organization of the United Nations
FGD	Focus Group Discussion
FMD	Foot-and-mouth disease
FY	Fiscal Year
GHG	Greenhouse Gas
GAP	Good Agricultural Practice

GoB	Government of Bangladesh
HHs	Households
ICT	Information and Communication Technology
ILST	Institutes of Livestock Science and Technology
IPCC	Intergovernmental Panel on Climate Change
kg	kilogram
KII	Key Informant Interview
LRI	Livestock Research Institute
LSP	Local Service Provider
LSD	Lumpy Skin Disease
MEL	Monitoring, Evaluation, and Learning
MT	Metric Ton
MoFL	Ministry of Fisheries and Livestock
MoEFCC	Ministry of Environment, Forest and Climate Change
NGO	Non-Government Organization
N_2O	Nitrous Oxide
PG	Producer Group
PPR	Peste Des Petits Ruminants
PMP	Performance Monitoring Plan
PO	Producer Organizations
SBC	Social Behavior Change
SD	Standard Deviation
SHFs	Small-holder Farmers
SMEs	Small and Medium-sized Entrepreneurs
ToR	Terms of Reference
UNEP	United Nation Environment Programme
ULO	Upazila Livestock Officer
UNIDO	United Nations Industrial Development Organization
USDA	United States Department of Agriculture
USD	United States Dollar
VTIs	Veterinary Training Institutes
Y_m	Methane conversion factor

EXECUTIVE SUMMARY

Background of the project

The United States Department of Agriculture (USDA) awarded the Food for Progress Bangladesh Climate Smart Livestock (BCSL) project to ACDI/VOCA on October 1, 2023. The total budget of the project is USD 16.625 million. The project aims to enhance livestock productivity, focusing on 16 districts in Bangladesh. The project seeks to increase the production and productivity of milk from cattle and meat from cattle and goats by improving animal health and promoting the adoption of advanced production technologies while reducing greenhouse gases per unit of milk and meat produced. Additionally, the project aims to boost trade and profitability in the livestock sector by connecting producers to end buyers and increasing access to investment capital.

The project targets to reach a total of 250,000 beneficiaries, inclusive of which 200,000 smallholder livestock farmers possessing 3 to 20 cattle and goats, will adopt good agricultural practices (GAPs) and technologies. This adoption is expected to increase productivity on target farms by approximately 35 percent, reduce direct greenhouse gas emissions from livestock by around 17 percent, enhance sales, and support the Government of Bangladesh (GoB) in achieving its regulatory goals. Ultimately, these efforts will contribute to increased livestock productivity and the availability of products for domestic, regional and international markets.

Purpose, objectives and expected use of the study

The objectives of the baseline study are to verify and eventually revise, if required, the baseline values for the outcome and output indicators listed in the Performance Management Plan (PMP) and lay the groundwork for performance and impact assessment by providing a benchmark for comparison during the mid-term review and the final performance evaluation. The baseline study will also provide the status of the prevailing conditions and resources of the livestock farmers in the target districts, other value chain actors in the sector, and services provided by government agricultural extension and research agencies to support the productivity and growth of the livestock sector. The study will also address key learning questions to aid activity implementation as well as support informed decision-making across the life of the project. Finally, the results of the baseline study will highlight the insights that could be used, if required, to refine the theory of change and to verify and eventually revise the draft baseline values and targets in the monitoring and evaluation indicators for performance monitoring.

Methodology

The study adopted a multi-pronged approach and was conducted through (i) desk reviews, (ii) a quantitative survey, and (iii) a qualitative study with Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs). For the quantitative survey, data were collected from 1,753 households across the 16 project districts. The survey included a subset of 467 households (within 1,753 households) especially for generating data required for estimation of methane emissions. A structured questionnaire was developed, pre-tested, validated, and used for quantitative data collection under pre-determined three household categories - Marginal (with 3-5 cattle heads), Smallholder (with 6-10

cattle heads) and Medium (with 11-20 cattle heads). The survey data were collected from the field by using the online data collection software Kobo toolbox. A semi-structured questionnaire with open-ended questions was developed and used for qualitative data collection, which included 32 FGDs and 63 KIIs. The FGDs were conducted across the farmers belonging to producer groups and individuals. The KIIs were conducted with selected value chain actors, including producers, input dealers, aggregators, retailers, processors, financial service providers, government agencies, research organizations, and other industry stakeholders. The results of the baseline study were validated through a national stakeholders' workshop with representation from ACDI/VOCA in-country and headquarters.

Data analysis

Before undertaking analysis, curation of field survey data was undertaken. For this purpose, the data were extracted from the Kobo toolbox system to MS Excel and MS Access. Those data, as per attributes of the specific results format, were summarized as mean and standard deviation. The analysis followed the guidance in the U.S. Department of Agriculture Food for Progress BCSL-approved PMP document. The results were disaggregated into sub-attributes as per the requirements of the PMP. The estimation of the greenhouse gas emissions (GHG) was carried out following the Intergovernmental Panel on Climate Change (IPCC) guidelines and Tier 2 methodology. To confirm and/or strengthen the quantitative findings, the information gathered in the FGDs and KIIs was used for triangulation. Eleven outcome indicators in the PMP were estimated using the baseline quantitative survey data through rigorous consultation with the BCSL Monitoring, Evaluation and Learning (MEL) team. The 'conceptual analysis', which includes 'Key discussions' and 'Recommendations' sections, resulted from critical thinking and peer discussions; the peers included BCSL key personnel.

The striking findings

The defined approach to achieve the two strategic objectives of the project, a prototype of the Theory of Change (ToC), focuses on enhancing productivity in cow milk, cattle meat (carcass), and goat meat systems in relation to greenhouse gas emissions, indicating that increased productivity leads to a reduction in emissions per unit of production, rather than creating a tradeoff. Thus, the proposed approach is a 'double win'.

Major findings

Demography: The survey revealed that the average family size of the 1,753 HHs was 4.5 with a 51:49 male-female ratio. Age-wise, 33.4 percent and 28.3 percent belonged to the 36 – 60 and 18 – 35 years age groups, respectively. Sixty-eight percent of HH members had received some formal education, at least primary schooling.

Household income: About 11.2 percent of HHs sourced primary income from the livestock sector. The average annual income of the surveyed HHs (BDT 373,784) was very close to the national average (BDT 398,084). The average annual income from livestock was BDT 160,948. accounting for approximately 43 percent of the total income. When broken down by household category, the average total income per household was BDT 98,258 for marginal households, BDT 275,295 for smallholder

households, and BDT 608,880 for medium households. About 83 percent of HHs owned land, including homesteads, averaging 129 decimal (5,221 square meters). The female headed HHs was 4.3 percent.

Livestock ownership

Cattle breeds*:* In Bangladesh, cattle breeds are primarily classified into two categories: local breeds and crossbred. Local breeds include indigenous varieties such as the Red Chittagong, Pabna, and Munshiganj breeds, North Bengal Grey cattle etc. These breeds are known for their adaptability to local environmental conditions, disease resistance, and lower maintenance costs. However, they typically have lower milk yields compared to crossbreeds. On the other hand, Crossbreeds are produced by crossing local breeds with high-yielding exotic breeds such as Holstein Friesian, Jersey, Sahiwal and Tharparkar cattle etc. Crossbreeds are often more productive in terms of milk yield but may require better management, higher-quality feed, and improved veterinary care.

Ownership: The survey indicated that the proportion of crossbreeds in dairy cattle, beef cattle, and goats were 56 percent, 62 percent, and 22 percent, respectively. The average number of cattle per household was 3.4 for marginal households, 7.5 for smallholder households, and 14.4 for medium households. Crossbreeds are more prevalent in milk and meat production from cattle across all household categories, with the highest proportion in smallholder households for milk (60 percent) and in marginal and medium households for meat (63 percent). In contrast, local breeds dominate goat production, especially in smallholder and medium households.

Productivity: The milk yield and beef productivity crossbred, and local cattle is presented in Table E1. The average yield of milk per cow was 5.1±4.1 liters per day. The average annual lactating cycle was 187 days for the local breed and 232 days for the crossbreed. Local breed cows produced an average of 2.00±1.4 liters, which is lower than crossbreed cows (7.4±3.4) liters per day. The milk yield from crossbreed cows in marginal (7.0±3.7 liter/day) and smallholder (7.4±4.2 liter/day) HH was very similar, but in medium HH it was higher (9.5±4.2 liter/day). On the contrary, the milk yield of local breed cows was similar, in the range of 1.8±0.6 to 2.3±1.8 liter/day, across the three HH categories.

Table E1: Milk and meat productivity by breed types

Breed types	Milk yield ± SD (liter) per cow per day	Milk production ± SD (liter) per cow per lactation	Meat production ±SD (kg) per cattle per year
Crossbred	7.4±4.0	1,746±1,009	107±43
Local	2.0±1.4	369±248	78±36

The average cattle meat (carcass) yield (including flesh and bones) was estimated at 96±43 ±SD kg per head, with crossbred producing higher, on an average of 107±43 kg, than local breeds producing an average of 78±36 kg. Average cattle meat weight per animal was higher in medium HHs compared to smallholder or marginal HHs. Local breeds produced less meat in medium HHs than in marginal and smallholder HHs. The average annual meat production per goat was 6.5±2.0 kg. Crossbred goats exhibited higher productivity, yielding 8.9±3.0 kg per year, which is 1.53 times greater than the 5.8±2.0 kg produced by local breeds.

Volume and sales: A total of 40.7 percent (714 HH of 1,753 HH) of the surveyed households sold cattle meat (carcass), 66 percent (309 HH of 467 HH) sold milk, and 16.5 percent (290 HH of 1,753 HH) sold goat carcasses. Cow's milk sales amounted to USD 0.256 million, with a significant share, USD 0.22 million, generated from crossbred, while local breeds contributed USD 0.036 million. The average sales revenue per cow was USD 957 for crossbred and USD 202 for local breeds, while at the household level, the average milk sales revenue stood at 828 USD per household. Furthermore, a total of 588 Metric Tons (MT) of milk were sold, predominantly from crossbred (506 MT), while sales from local breeds was 82 MT.

A total of 1,611 cattle were sold, comprising 1,047 crossbred and 564 local breeds (Table E2). Total cattle meat (carcass) sales amounted to USD 0.915 million, with crossbred generating USD 0.664 million and local breeds contributing USD 0.251 million. The total volume of cattle meat (carcass) sales was 160 Metric Tons (MT), with crossbred accounting for 116 MT and local breeds for 44 MT. The average sales revenue per cow was USD 634 for crossbred and USD 443 for local breeds, while the annual household-level earnings from cow sales averaged 1,123 per household.

A total of 617 goats were sold, generating USD 0.046 million in sales revenue, with an average price of USD 75 per goat. At the household level, annual earnings from goat sales averaged USD 159 per household (290 HH). Additionally, the total volume of goat meat sold reached 5 Metric Tons (MT).

Table E2: Annual volume and sales of milk and meat by breed types

Breed types	Number of Ruminants			Sales volume (MT)			Annual sales (USD million)		
	Dairy cattle	Beef cattle	Goat	Milk	Cattle carcass	Goat carcass	Milk	Cattle carcass	Goat carcass
Crossbred	230	1,047	-	506	116	-	0.22	0.664	-
Local	178	564	-	82	44	-	0.036	0.251	-
Total	408	1,611	617	588	160	5	0.256	0.915	0.046

Market linkages: 'Goalas' (street milk vendors) and the local market were the key marketing points for milk and cattle sales. These informal channels provided convenience but resulted in inconsistent pricing, underpayment, and lack of quality control. The price of milk appeared slightly higher in local breed cows than in crossbred. The average selling price of cattle was BDT 100,000 per head.

Good agricultural and improved management practices: Fodder management is considered a key agricultural-smart practice that enhances animal health, particularly when green grass is unavailable. Among 467 sub-sampled households, 42 percent cultivated fodder using Napier grass, with 94 percent using their land and 6 percent leasing land, mostly by marginal farmers (83 percent). Medium-scale farmers allocated more land (0.40 ± 0.9 ha) compared to marginal (0.03 ± 0.03 ha) and smallholder (0.03 ± 0.05 ha) farmers. Fodder cultivation was practiced in all 16 project districts, but adoption was comparatively higher in Jashore, Bogura, Sirajganj, Jhenaidah, and Natore than in other districts.

Feed consumption: On average, single cattle were fed daily with 7.1 kg of straw, 11.6 kg of green grass, and 1.3 kg of concentrate. Specifically, local cattle received 7.1 kg of straw, 10.4 kg of green grass, and 1.2 kg of concentrate per day, while crossbred cattle were given 7.1 kg of straw, 11.9 kg of green grass, and 1.5 kg of concentrate daily. Although the feed quantities were consistent across

different household categories, regional variations in feeding practices were observed among the surveyed households.

Animal health and cattle management: Disease treatment and vaccination are essential components of livestock management, contributing to improved productivity and reduced mortality rates. About 76 percent of HHs treated diseased cattle and 4.7 percent of animals (cattle and goats) were vaccinated. About 65 percent of HHs applied artificial insemination (AI) as part of their cattle management practices. Some farmers reported a reduction in milk production due to diseases, although the survey was not able to quantify the exact amount of this loss.

Calf mortality and diseases: The baseline survey revealed that 198 cows (2.4 percent) out of 8,199 surveyed across different household categories died due to various diseases over the past 12 months. The leading causes of cow deaths were Seizures/Anthrax (20.7 percent) and Lumpy Skin Disease (19.7 percent), affecting all household categories. The calf mortality rate was approximately 5.2 percent and the reported deaths were predominantly from lumpy skin disease.

Access to finance: Only 17.8 percent of the surveyed households had access to financial services which was on average BDT 82,466 and predominantly accessed through MFIs and NGOs. This indicates that most households in the study area face barriers to accessing credit and often rely on informal borrowing mechanisms. Among households who took loans in the last 12 months, they faced issues such as high interest rates (28.8 percent), followed by lack of awareness (11.8 percent), insufficient collateral (3.2 percent), complex loan application processes (2.9 percent) and limited financial institutions in the area (1.6 percent) exacerbate these challenges. In addition, a lack of understanding of livestock farmers' unique needs by financial institutions is a significant barrier. The interest rate was stable across locations at 14 percent. Farmers primarily used loans to enhance productivity, including cow fattening (62.9 percent), increasing milk production (35 percent), and goat fattening (18.2 percent).

Women and youth engagement: The share of participation of youth (18 – 35 years of age) in cattle management was relatively small (about 7.3 percent of the total surveyed HHs); gender-wise, male youth accounted for 3.1 percent and female youth 4.2 percent.

Capacity development: Only six percent of households surveyed received training, with marginal households being the largest beneficiary group. This low outreach indicates a significant gap in capacity development efforts by government extension agents and/or non-governmental organizations. Additionally, the limited participation of women highlights a critical deficiency in inclusive training initiatives.

GHG emissions: Estimated average methane emission was 2.7 kg CO_2.eq kg^{-1} milk; local breeds emitted higher methane per unit of production (4.2 kg CO_2.eq kg^{-1} milk) than crossbred (1.6 kg CO_2.eq kg^{-1} milk). Methane emission was 11.2 kg CO_2.eq kg^{-1} cattle meat (carcass); local breeds emitted higher methane per unit of production (12.6 kg CO_2.eq kg^{-1} meat) than crossbred (10.3 kg CO_2.eq kg^{-1} meat). The estimated average methane emission was 14.6 kg CO_2.eq kg^{-1} goat meat; local breeds emitted higher methane per unit production (14.9 kg CO_2.eq kg^{-1} meat) than crossbred (13.4 kg CO_2.eq kg^{-1} meat).

Limitations of the study

There are two major limitations with the baseline survey data. One, the study could not collect sufficient data about manure management and therefore did not estimate methane emissions from manure. Second, improved management practices needed more data to understand the detailed scenarios in the field.

Answering the four learning questions

1. **What are the levels of GHG emissions per unit of production (milk, beef, and goat meat) and what are recommendations for reducing emissions efficiently?** The estimated average methane emissions were 2.7 kg CO_2.eq per kg of milk, with local breeds emitting more (4.2 kg CO_2.eq per kg of milk) compared to crossbred (1.6 kg CO_2.eq per kg of milk). For cattle meat (carcass), methane emissions averaged 11.2 kg CO_2.eq per kg, with local breeds emitting higher levels (12.6 kg CO_2.eq per kg of meat) than crossbred (10.3 kg CO_2.eq per kg of meat). Similarly, for goat meat, the average methane emissions were 14.6 kg CO_2.eq per kg, with local breeds emitting 14.9 kg CO_2.eq per kg of meat compared to 13.4 kg CO_2.eq for crossbred.

2. **What strategies and approaches are most successful at incentivizing desired behavior changes of government staff?** The BCSL project aims to boost productivity, trade, and reduce GHG emissions in the livestock sector, collaborating closely with government bodies like the Department of Livestock Services (DLS), Department of Environment (DoE), and Bangladesh Livestock Research Institute (BLRI) for technical expertise. Recognizing that government staff might view non-government efforts as a challenge to their credibility, BCSL should commit to building trust and advocating for accountability, demonstrating that its work complements, rather than competes with, government efforts. Through continuous rapport-building, the project should integrate government officials in key activities, such as steering committees, planning and reporting sessions, field visits, and specialized training, including sponsored international training and on-station trials at BLRI facilities. By involving officials directly, creating platforms for shared knowledge, and promoting transparent collaboration, BCSL should aim to foster mutual understanding and accountability, positioning itself as a collaborative partner in advancing sustainable livestock sector goals.

3. **Using a cost-benefit analysis, what is the net profit from current livestock production techniques and management practices, including feeding, pest, and disease management?** The baseline study evaluated the profitability of livestock production by examining income and expenditure patterns among Marginal, Smallholder, and Medium-scale farmers. These categories were based on herd size, with Marginal farmers owning 3-5 cattle, Smallholders 6-10, and medium farmers 11-20. Data collected over the past 12 months showed that medium farmers earned the highest annual income of BDT 608,880, largely due to increased milk production and livestock sales, followed by Smallholders with BDT 275,295 and Marginal farmers with BDT 98,258. Income sources across all groups included selling milk, cattle, cow dung, and goats, with Smallholders and Medium farmers benefiting more from cattle sales as a significant revenue stream.

In terms of expenditures, medium farmers also incurred the highest costs, spending BDT 234,057 annually on feed, veterinary care, and herd expansion, while Smallholders and Marginal farmers spent BDT 103,565 and BDT 47,280, respectively. Despite higher costs, profitability remained strong, with medium farmers securing the highest net profit of BDT 374,823, Smallholders earning BDT 171,730, and Marginal farmers generating BDT 50,978.

4. **Are there differences in revenue or income for different types of LSPs[1] (adult men, adult women, male youth, and female youth)? What are the main factors or challenges that contribute to differences?** Are there differences in revenue or income for different types of LSPs (adult men, adult women, male youth, and female youth)? What are the main factors or challenges that contribute to differences? Livestock Service Providers (LSPs) showed notable income disparities influenced by gender, experience, location, and culture. Female LSPs, mostly offered basic services and earned between BDT 5,000-10,000 monthly, male LSPs providing comprehensive services earned between BDT 25,000-50,000. Male LSPs significantly outnumbered females, with a 6:1 ratio, and benefit from larger networks, mobility, and access to resources, leading to greater demand and business growth. Female LSPs faced cultural and security constraints limiting their mobility, geographic reach, and service scope, with societal biases favoring male providers. Some of the differences could be minimized through skill development among LSPs, as clients tend to pay for the skills. The project should prioritize the capacity building of young LSPs, both male and female.

Key Observations

i. While productivity is a key driver of increased milk and meat production volumes, its relationship with total household income was not established. Productivity did not exhibit significant variation across different income levels.

ii. The increase in per-unit productivity of milk and meat followed an exponential decay curve (or a power distribution) about methane emissions per unit of productivity.

iii. Manure disposal practices are strongly influenced by beneficiaries' attitudes, which are likely shaped by traditional norms. To address this, the project could conduct an in-depth formative study on manure management in its second year, alongside several pilot initiatives.

Recommendations

Some major recommendations have been given already in answering key questions and observations. Additional recommendations are:

- **Follow the proposed strategic pathway for achieving the two strategic objectives**: The strategy places the 'enabling environment' at its core, which is to be established through coordinated government efforts and enhanced farmer knowledge, with the project providing a supportive, backstopping role. Key project activities such as training beneficiaries, improving access to inputs,

[1] LSPs also serve as community vaccinators and extension agents. A related issue could be unequal pay for equal work, a challenge seen globally. This disparity often arises from employer discrimination and the limited negotiation skills of women in the workforce. The project can address this through GYSI action plans, working with key employers to tackle unequal labor practices and human resource policies.

markets, financial services, and overall capacity development will form one stream of contributions to this enabling environment. To promote women's engagement and empowerment, as well as to revitalize the livestock sector, women and youth perspectives driven by political commitment will constitute another stream of contributions. These combined efforts will yield two key outcomes: (i) increased productivity, production, and profitability, and (ii) effective greenhouse gas management and sustainable land resource conservation.

- **Create three separate pathways** - milk, meat, and cow dung components – in a matrix of household categories and activities (or interventions) phase by phase, as explained in section 8.4.
- **Develop market systems**: Strengthening market connectivity is crucial for market system development. This can be achieved in two key dimensions: horizontal and vertical. Horizontal connectivity focuses on increasing the consumption of milk and meat, expanding market reach at the community level. Vertical connectivity, on the other hand, involves establishing aggregation centers at local and upazila levels to streamline supply chains. Additionally, improving access to finance plays a vital role in enhancing market linkages at district and national levels, fostering a more integrated and efficient market system.
- **Consult with government officials** especially with the Department of Livestock Services (DLS) and Bangladesh Bureau of Statistics (BBS)) if there is any plan to change in the modality of estimation of national meat and milk production and productivity. The project should use the same estimation techniques.
- **GHG emissions estimation:** Think about how disaggregation of the cattle population can be done on a larger scale. For example, a nationally agreed or accepted proportion of animal subgroup within each category (e.g., dairy cattle, non-lactating cows, heifers and calves, within milk-cows and bulls, bullocks and calves within meat-cattle etc.). This will be required to estimate national GHG emissions.
- **Manure management:** Conduct a study to evaluate the capabilities, opportunities, and motivations of different farmer segments in manure management. Based on the study's findings, develop a Social Behavior Change (SBC) strategy tailored to each segment, with recommended behaviors and pilot implementations.

1. INTRODUCTION

BACKGROUND

On March 31, 2024, ACDI/VOCA engaged the Center for Natural Resource Studies (CNRS) to conduct a Baseline Study for the United States Department of Agriculture (USDA) Food for Progress Bangladesh Climate Smart Livestock (BCSL) Project, hereafter referred to as the 'baseline study.' The study adopted a comprehensive approach and methodology integrating both quantitative and qualitative tools and was conducted from July to September 2024. A validation workshop was held on December 12, 2024, to gather stakeholder feedback, ensuring the accuracy and relevance of the findings. This was followed by additional refinements in January and February 2025, incorporating stakeholder insights and further statistical validation to strengthen the depth and reliability of the data analysis. The revised findings were then presented, allowing for a more evidence-based interpretation of the results and ensuring that the final report accurately represents the project's baseline conditions.

Country landscape

Production of cattle milk and meat is not meeting domestic consumption growth, resulting in shortfalls.[2] Challenged in the livestock and dairy sector have led to low productivity, low production volumes, market access constraints, and unmet local demand for primary and value-added products. Low productivity results in unnecessarily high greenhouse gas (GHG) emissions per unit of meat or milk produced. Furthermore, climate change impacts on the livestock production system threaten to hamper the growth and development of the sector. About 70 percent of rural households – 6 million people, 40 percent of who are women – engaged in livestock production, their limited livestock assets are increasingly exposed to risks associated with natural events and disease outbreaks.[3]

The enabling environment for livestock and dairy market system is weak, with most of Bangladesh's Small-Holder Farmers (SHFs) and Small and Medium-sized agro-entrepreneurs (SMEs) lacking adequate knowledge of livestock management practices and technologies that could improve their productivity, income, and resilience.[4]

Priority value chains

Dairy cattle: Milk production in Bangladesh in 2019 was 10.5 million Metric Tons (MT), enough to supply about 50 percent of the recommended daily intake per capita.[5] Milk production in Bangladesh is characterized by small mixed crop-livestock producers with low productivity. Productivity in Bangladesh varies widely from 228-671 liters of milk per lactation (depending on breed),[6] compared to 700L for Asia.[7] SHFs typically have lower productivity rates compared to large dairy processors.

[2] *Salim HM (2022). Livestock Economy at a Glance. Dhaka: Bangladesh Department of Livestock Services. Dhaka.*
[3] *World Bank (2018). Livestock and Dairy Development Project. Press Release.*
[4] *Oman S., Liang W (2019). The Dairy and Beef Value Chain in Bangladesh. UNIDO.*
[5] *IDRN (2020). Integrated Dairy Research Network. Monthly Dairy Sector Update. Bangladesh Agricultural Univ., Bangladesh.*
[6] USAID Livestock And Nutrition Activity, ACDI/VOCA Baseline Study (2021).
[7] *Gen Econ Div (2020). 8th Five Year Plan July 2020-June 2025. Dhaka: Bangladesh Planning Commission*

Over 80 percent of milk sales occur through informal channels, leaving the large dairy processors that operate nationally without enough milk to operate efficiently.

Beef cattle: Beef represents well over half of all meat (including poultry) consumed by Bangladeshis, with half of annual consumption occurring during the Eid al-Adha holiday. SHFs are responsible for most beef production, fattening cattle with locally available fodder. A small number of cattle fattening operations have arisen but remain relatively rare. Ninety percent of beef is sold in the informal market.[8] While official figures from the Department of Livestock Services (DLS) estimated domestic beef production for FY 2021-22 at 3.4 million MT, more than enough to meet the estimated demand of 2.2 million MT. However, there is strong evidence that DLS overestimates production figures[9] to the extent that actual production is in fact less than consumption, making imports necessary to meet demand.

Goat meat: Estimates for goat meat productivity vary widely. A United Nations Industrial Development Organization (UNIDO) study estimated goat meat production in FY 2021-22 to be approximately 287,000 MT, based on a goat population of about 27 million, an average carcass weight of 19.5 kg, and a slaughter rate of 55 percent annually[10]. Another estimate, however, puts goat productivity at 11kg/head[11]. Most SHFs work with traders to sell their goats to local butchers, making it difficult for processors like Bengal Meat to satisfy the rising demand for goat meat in urban areas. As with beef and dairy, the primary goat producers are SHFs, particularly women, and integration into formal value chains is minimal.

Needs to be addressed

Limited incorporation of good agricultural technologies in the livestock sector: The livestock sector lacks the incentives to deliver the products, services, and information needed to improve productivity and increase incomes while managing resources efficiently. The dominant smallholder livestock production system in Bangladesh is marked by limited knowledge and application of cost-effective good agricultural practices that can maximize productivity using locally sourced, limited resources. As a result, milk and meat production systems are inefficient, GHG emissions per unit produced are high, farmer incomes are low, and SHFs are poorly prepared to confront environmental shocks. Appropriate business models employed by technology providers fall short of delivering solutions to the majority of SHFs and support systems for entrepreneurs and Business Development Services (BDS) are limited. An animal breeding and genetic improvement strategy still needs to be clearly formulated.

Shortage of agricultural inputs and services for improved animal health management: In addition to animal nutrition constraints, milk and meat production among SHFs are constrained by a shortage of quality animal healthcare. Vaccination and quarantine protocols are absent or underutilized. Antimicrobials, acaricides (against ticks), and anthelmintics (dewormers) are sold without a prescription and often used inappropriately, resulting in failed treatments and the promotion of antimicrobial and antiparasitic resistance[12]. Foot-and-Mouth Disease (FMD) and Lumpy Skin Disease

[8] CIAT, World Bank (2017). *Climate-Smart Agriculture in Bangladesh*. Washington, DC: CIAT, World Bank.
[9] CIAT, World Bank (2017). *Climate-Smart Agriculture in Bangladesh*. Washington, DC: CIAT, World Bank.
[10] Oman S., Liang W (2019). *The Dairy and Beef Value Chain in Bangladesh*. UNIDO.
[11] USAID Livestock And Nutrition Activity, ACDI/VOCA Baseline Study (2021).
[12] Personal com., Nasrin Sultana Juyena, Faculty of Vet. Science, Bangladesh Agric. Univ., Dhaka, 4 April 2023.

(LSD) in cattle and *Peste Des Petits Ruminants* (PPR) in goats, and bovine ephemeral fever are the most consequential transmissible diseases. Farmers know little about their breed composition or the artificial insemination services they hire, making it impossible for them to formulate a coherent strategy to optimize breed type. The presence of public livestock extension and veterinary officers at the upazila level is insufficient to reach many farmers, and private veterinarians are scarce in rural areas. Para-veterinarians and Community-based Animal Health Workers (CAHW) are nascent models, further limiting the availability of Animal Health (AH) services and inputs, leaving SHFs poorly informed. While over 4,000 Local Service Providers (LSPs) have been trained and deployed to deliver private livestock services over the past two decades, coverage is still limited, training in AH is often too short, and LSPs lack formal authority to administer antimicrobials or vaccines to animals. The absence of formal recognition prevents the establishment of minimum standards for their training and competency, hinders monitoring of their work, and reduces public confidence in their abilities.

1.1 BRIEF PROJECT DESCRIPTION

The United States Department of Agriculture (USDA) awarded the Food for Progress Bangladesh Climate Smart Livestock (BCSL) project to ACDI/VOCA on October 1, 2023. The project aims to enhance livestock productivity, focusing on 16 districts[13] in Bangladesh. The project seeks to increase the production and productivity of milk and meat from cattle and goats by improving animal health and promoting the adoption of advanced production technologies, Additionally, the project aims to boost trade and profitability in the livestock sector by connecting producers to end buyers and increasing access to investment capital. The project is organized around the following four components and five key activities.

Box 1: Activities by component relating to the results framework

Component 1: Incorporating Climate Smart Technologies in the Livestock Sector
Activity 1: Training: Improved Agricultural Production Techniques
Component 2: Improved Animal Health Management Practices
Activity 2: Inputs: Develop Veterinary Services
Component 3: Strengthen Extension and Service Providers
Activity 3: Market Access: Facilitate buyer-seller relationships
Activity 4: Financial Services: Facilitate agricultural lending and risk reduction strategies
Component 4: Coordination with Government of Bangladesh and other Donors
Activity 5: Capacity Building: Promote Improved policy and regulatory framework

To achieve these goals, the project leverages the institutional capacity and experience of the Government of Bangladesh (GoB) with donor support. It specifically targets livestock farmers with 3 to 20 cattle or goats, as well as key stakeholders including input and output market actors, LSPs, public and private livestock extension agents, and representatives from livestock associations. The project promotes access to knowledge, services, relationships, investment, and markets for all stakeholders, following good agricultural systems and technologies.

[13] *BCSL project's working districts: Satkhira, Jashore, Kushtia, Jhenaidah, Chuadanga, Bogura, Pabna, Natore, Noagaon, Gaibandha, Joypurhat, Jamalpur, Sirajganj, Rajshahi, Kurigram and Rangpur.*

The project aims to reach a total of 250,000 beneficiaries, including 200,000 smallholder livestock farmers who will adopt good agricultural practices and technologies. This adoption is expected to increase productivity on target farms by approximately 35 percent, reduce direct greenhouse gas emissions from livestock by around 17 percent, enhance sales, and support the Government of Bangladesh (GoB) in achieving its regulatory goals. These efforts will contribute to increased agricultural productivity and the availability of products for domestic, regional, and international markets.

The baseline study targeted livestock farmers producing beef, goat meat, and milk across all 16 districts. It also included other value chain stakeholders such as input and output market actors (including input retailers, dealers, traders, processors, and buyers), representatives of livestock producer associations, financial institutions, and relevant government departments, i.e., Department of Livestock Services (DLS), Department of Agricultural Extension (DAE), Ministries of Fisheries and Livestock (MoFL), and Ministry of Environment, Forest and Climate Change (MoEFCC) as well as local research institutions and universities. This comprehensive approach ensured representation of all key aspects of the livestock sector.

The BCSL project focuses on enhancing the productivity and sustainability of livestock commodities, specifically meat and milk. Additionally, the project aims to improve and expand the trade of livestock by strengthening the performance of value chain actors and leveraging the commitments and investments made by the Government of Bangladesh and donors to boost productivity and trade in the sector.

1.2 JUSTIFICATION OF THE STUDY

The national consultancy firm, Center for Natural Resource Studies (CNRS), conducted the baseline study for the BCSL project through an agreement signed on March 31, 2024. The study aimed to establish benchmark information from livestock farmers and market actors while gathering data from various stakeholders, including private sector entities, and relevant government agencies, to ensure comprehensive coverage of livestock sector-specific aspects. This study was conducted by a team of multidisciplinary experts, research associates, and assistants.

During the baseline study, critical variables related to the project's objectives were identified, and baseline values were established to enable impact evaluations at key intervals and upon project completion. The findings and analysis of the baseline report documented pre-project conditions in the implementation areas, aligned with the project's objectives.

The baseline survey was conducted to gain a deeper understanding of the underlying factors affecting smallholder livestock farmers and the broader livestock sector and to establish baseline values for indicators within the BCSL intervention area. The survey results will guide the BCSL team in effectively deploying the project's five key activities. A mixed-method approach was employed, combining quantitative and qualitative methodologies. The qualitative component included exploratory and explanatory elements, various sub-components, and a cost-benefit analysis. The study also aimed to comprehensively assess the baseline status of key indicators critical for achieving project outcomes and outputs, ensuring alignment with related government initiatives in Bangladesh.

1.3 OBJECTIVES AND USES OF THE BASELINE STUDY

1.3.1 Study Objectives

The objective of the assignment is to establish baseline data on sample livestock producers and other key stakeholders across key indicators aligned with the project's objectives. The baseline survey results will serve as a reference point to measure the BCSL project's impact during future evaluations, such as the mid-term and end-line assessments.

The specific objectives of the baseline study are:

- Verify and, if necessary, revise the baseline values for outcome and output indicators listed in the Performance Monitoring Plan (PMP) to ensure accurate measurement of the project's performance.
- Establish a benchmark for comparison to support performance and impact assessments during the mid-term review and final evaluation.
- Provide an overview of the current conditions and resources of livestock farmers and other value chain actors in the target districts.
- Assess the services provided by government agricultural extension and research agencies to enhance productivity and growth in the livestock sector.
- Provide insights to address key learning questions that will guide activity implementation and support informed decision-making throughout the project.
- Provide inputs that could be used to refine the theory of change by using the insights gained and revise the draft baseline values and targets in the monitoring and evaluation indicators for effective performance monitoring.
- Analyze the information to support ACDI/VOCA's culture of Collaboration, Learning, and Adapting (CLA) to enable continuous learning and adaptive management, modifying strategies and interventions as needed.

1.3.2 Uses of the Baseline Study

The baseline study will provide the status of the prevailing conditions and resources of the livestock producers in the target districts, other value chain actors in the livestock sector, and services offered by the government Department of the Livestock Services (DLS) and Bangladesh Livestock Research Institute (BLRI) to support the productivity and growth of the livestock sector. Finally, the baseline study results would provide insights that could be used to refine the theory of change and verify the draft baseline values and targets in the performance monitoring plan.

2. METHODOLOGY

A mix of quantitative and qualitative research methodologies was used in conducting this baseline study. These methodologies and tools were a) Desk review, b) Survey from a list of producers using a structured questionnaire, c) Key Informant Interviews (KIIs), and d) Focus Group Discussions (FGDs).

The project measures its success through 31 key indicators (Annex A1: Table 2.1) of which 11 indicators were measured using this baseline study. The indicators encompass various aspects such as sales value and volume, participation in food security programs, training, employment, indirect beneficiaries, and income gains from livestock production. It also assesses progress in areas including adaptation, access to resources for youth and women, yield improvements, management practices, research uptake, vaccination rates, calf mortality reduction, greenhouse gas emissions, access to finance and loans, partnerships, organizational performance, service satisfaction, market information access, investments, processing capacity utilization, and policy development. These metrics provide a basis for a comprehensive assessment of the project's impact on agricultural productivity, sustainability, and market integration. Table 2.1 below matrix shows the list of indicators measured through this baseline study and data collection mechanism.

Table 2.1: Indicator list and data collection mechanism

Sl	Indicator	Data Collection Mechanism
1	Value of annual sales of farms and firms receiving USDA assistance	Data was collected through the survey in which participants reported the quantity of meat and milk sold over the past 12 months, along with the corresponding sales value. The data was further verified through Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs).
2	Volume of commodities sold by farms and firms receiving USDA assistance	Data was collected through the survey in which participants reported the quantity of meat and milk sold over the past 12 months, along with the corresponding sales value. The data was further verified through Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs).
3	Yield of targeted agricultural commodities among project participants with USDA assistance	Data was collected through the survey in which participants reported the lactation period of the dairy cattle along with the highest and lowest amount of milk production value to calculate the Yield of Milk. Girth and Length of the ruminants were measured to estimate live weight during the survey and Meat Yield was calculated accordingly. The milk data i.e. lactation period, was further verified through Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs).
4	Number of hectares under improved management practices or technologies that promote improved climate risk reduction and/or natural resources	Data was collected through the household survey in which participants reported the amount of land where they had implemented improved management practices.

Sl	Indicator	Data Collection Mechanism
	management with USDA assistance	
5	Number of individuals in the agriculture system who have applied improved management practices or technologies with USDA assistance	Data was collected through the household survey in which participants reported applied improved management practices or technologies.
6	Number of hectares under improved management practices or technologies with USDA assistance	Data was collected through the household survey in which participants reported the amount of land where they had implemented improved management practices.
7	Percentage decline in calf mortality rate a result of USDA assistance	Data was collected through the survey in which participants reported the number of calf deaths over the past 12 months.
8	Percentage of cattle and goats vaccinated as a result of USDA assistance	Data was collected through the survey in which participants reported the number of cattle and goats vaccinated over the past 12 months.
9	GHG emissions eliminated, per unit produced (emission intensity) with USDA assistance	Quantitative data was collected through the household survey. The study used the IPCC Tier 2 methodology, as described in Chapter 10 of the IPCC document Emissions from Livestock and Manure Management[14] The emissions were calculated for individual animals under three categories - dairy cattle (169 local breeds and 228 crossbred dairy cattle, total 337), beef cattle (106 local breeds and 175 crossbred bulls, total 281), and meat goats (442 local breeds and 124 crossbred non-dairy goats, total 566).
10	Percentage of targeted livestock producers who are satisfied with the livestock services received from service providers	Quantitative data was collected through the survey in which participants rated various services they received from service providers. The data was further verified through Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs).
11	Percent utilization of installed processing capacity by participating firms as a result of USDA assistance	KII with processor (milk and meat)

[14] https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch10_Livestock.pdf

2.1 STUDY POPULATION

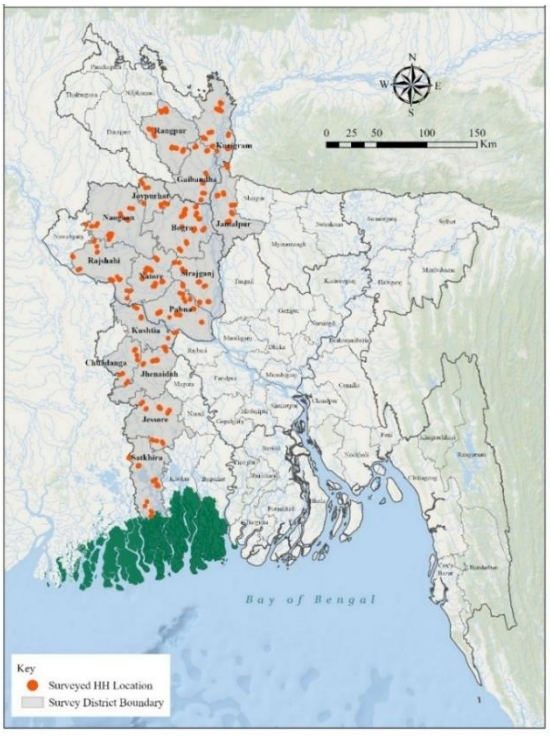
As stated in the Terms of Reference (ToR) the primary focus is on conducting a baseline study using a sample approach, with data collection at nine levels:

(1) Livestock and dairy product producers
(2) Producer organizations
(3) Concerned service providers
(4) Relevant research institutions and Universities
(5) Market actors including processors, farmer-based organization representatives, large buyers, exporters, input dealers
(6) Financial institutions
(7) Government offices, i.e., MoFL, DLS, MoEFCC, DAE
(8) ICT firms and business entities
(9) Development organizations staff

2.2 STRATIFICATION

The target beneficiaries include livestock farmers, specifically focusing on women and men including youth. Additionally, smallholder and medium enterprises, as well as producer groups (meat and milk), were considered. The project categorized farmers based on livestock ownership, including those classified as marginal, owning 3-5 cattle heads, Smallholders owning 6-10 cattle heads, and Medium, owning 11-20 cattle heads. The household survey locations are shown on the map (Figure 2.1).

Figure 2.1: Map showing the household survey locations in the project area



2.3 SAMPLING

The survey employed a multistage probability cluster sampling technique. The primary objective was to gather baseline information on the direct beneficiaries from the target area, adhering to the principle of randomization.

Assuming a 90 percent confidence interval, a 10 percent level of precision, and an estimated 52 percent probability of households owning livestock (p), the survey established the required sample size at the upazila (sub-district) level[15].

N = total number of upazilas in 16 districts
P = 0. 52

[15] *Third administrative tier of the government.*

Q = 0.48
Z = 1.96 at a 5 percent level of significance
D = 0.10, 10 percent margin of error

The equation (a) gives the required probable upazila sample size, of 16 districts collectively. It depends on the total number of covering Upazilas under the project districts, The initial calculation suggested sampling 44 upazilas across 16 districts. However, to ensure comprehensive representation, the BCSL project expanded the coverage to all 50 upazilas planned for the project's intervention, distributing the sample proportionately based on the number of upazilas per district and the number of livestock farmers as well.

The theory of probability cluster sampling for village sample size determination selection is:

$n = Nz^2pq/[(N-1)d^2 + Z^2pq]$ .....(a)

gives the required size
- p, the inherent cases of the variable under study, measured in terms of the probability of households having livestock and non-targeted percent is q,
- the acceptable margin of error in estimating a population parameter measured as d,
- the required level of confidence that the true value of the population parameters being estimated lies within the specified margin of error. This is measured in terms of z, the standard normal deviation.

Another formula for the Ultimate Sampling Units Viz. Producers for each division (16 districts under 4 divisions) member determination is:

$n = z^2pq/d^2$ .....(b)

For selecting producer farmers, a 95 percent level of significance was used (Z = 1.96) with a 5 percent margin of error. A cluster effect or design effect of 2 was factored in, recognizing that a cluster sample needs to be larger than a simple random sample to achieve the same level of accuracy. The total sample size was 1,753.

The sampling design also considered the geographical context, categorizing areas as rural, semi-urban/urban, and assessing their proximity to local administrative centers. All (16) districts were considered as the sampling frame of the study. To ensure balanced representation, the number of upazilas from each district was proportionally determined, followed by the selection of two unions per upazila and two wards per union (one located near and one farther from administrative or local government offices), resulting in a total of 100 sample unions and 200 sample wards. Households were then randomly selected from the sample villages, considering their proportion within household categories and the number of livestock farmers in each district. Additionally, the study included vulnerable areas (flood-prone, saline, and drought-prone) to capture data from areas at risk.

2.4 QUANTITATIVE DATA COLLECTION

The households' survey included a total of 1,753 respondents, of whom 885 were women (50.5 percent), proportionately distributed across the selected sample rearing cattle. Cattle are grouped by number for farm registration by the Ministry of Fisheries and Livestock (MoFL). The table below provides the data collection status by farmer categories[16] within the project areas.

Table 2.2: District-wise distribution of respondents by household categories

District	Household categories						Total
	Marginal		Smallholder		Medium		
	Number	Percentage	Number	Percentage	Number	Percentage	
Bogura	134	66.7	61	30.3	6	3.0	201
Chuadanga	52	85.2	8	13.1	1	1.6	61
Gaibandha	76	73.1	25	24.0	3	2.9	104
Jamalpur	71	71.7	24	24.2	4	4.0	99
Jashore	96	68.6	40	28.6	4	2.9	140
Jhenaidah	36	56.3	23	35.9	5	7.8	64
Joypurhat	39	88.6	4	9.1	1	2.3	44
Kurigram	93	72.1	30	23.3	6	4.7	129
Kushtia	36	94.7	2	5.3	-	-	38
Noagaon	104	80.0	25	19.2	1	0.8	130
Natore	78	70.3	31	27.9	2	1.8	111
Pabna	109	76.2	30	21.0	4	2.8	143
Rajshahi	90	84.1	12	11.2	5	4.7	107
Rangpur	84	68.3	37	30.1	2	1.6	123
Satkhira	90	76.3	26	22.0	2	1.7	118
Sirajganj	98	69.5	35	24.8	8	5.7	141
Total	1,286	73.4	413	23.6	54	3.1	1,753

The data was collected from households in July 2024. The supplementary survey of 467 households, selected from the 1,753 detailed survey households, aimed to observe the breed types in each household, focusing on the relationship between greenhouse gas emissions and milk and meat production across different livestock-rearing farmers' categories. A total of 1,753 smallholder farmers (including 50.5 percent of women respondents) were surveyed using the baseline questionnaire (Annex A2.2). The questionnaire was translated into Bangla and integrated into the Kobo Collect application to ensure that enumerators could easily understand and accurately conduct and record discussions.

[16] *Household categories are defined based on the number of cattle own by household - Marginal (3-5 cattle), Smallholder (6-10 cattle) and Medium (11-20 cattle).*

2.5 QUALITATIVE DATA COLLECTION

2.5.1 Focus Group Discussion (FGD)

Qualitative data collection methods, including Focus Group Discussions (FGDs), using open-ended questions or a checklist, were utilized to triangulate the quantitative data. A total of 32 FGDs were conducted with 351 participants, of whom 62 percent were women, with each session consisting of 10 to 12 participants (Annex-A1: Table 2.2). Both organized livestock Producer Groups (PG)[17] and independent livestock producers participated in the FGD sessions. These discussions were conducted to triangulate data and gather qualitative insights that complement the findings from the quantitative survey. Efforts were made to ensure adequate representation of women, men, and youth in the FGD sessions.

2.5.2 Key Informant Interviews (KIIs)

A total of 63 Key Informant Interviews (KIIs) were conducted with representatives from producer organizations, relevant service providers, market actors, processors, expert research institutions and financial institutions (Annex A1: Table 2.3).

2.6 DATA ANALYSIS METHODS AND PROCESSES

The household survey data were collected from the field using Kobo Toolbox, an online data collection software. After completing data collection, the data were extracted from Kobo Toolbox into MS Excel and MS Access for processing and analysis. Data cleaning and consistency checks were conducted to ensure the accuracy and reliability of the dataset before analysis. The quantitative data were analyzed using frequency tables, cross-tabulations, statistical tests, and visualizations to facilitate an evidence-based interpretation of results.

For qualitative data, collected through Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs), responses were systematically organized and categorized based on study objectives. Additionally, the study followed the guidelines outlined in the U.S. Department of Agriculture Food for Progress BCSL-approved Performance Monitoring Plan (PMP), maintaining methodological rigor. The analysis was further structured to allow comparisons across districts, commodities, gender, and age groups, distinguishing youth (15–29 years) and adults (30+ years) where applicable.

2.7 DATA MANAGEMENT AND PRESENTATION

The data represent all the surveyed households whose primary or secondary source of income was livestock. The following category, considering the number of cattle and goats, constitutes the household database.

[17] *The Government's Livestock Development and Dairy Project (LDDP) formed and worked with organized livestock farmers' groups, known as Producer Groups (PGs), to enhance collaboration and productivity. However, there are also independent livestock farmers who are not part of these organized groups, referred to as Non-Producer Group farmers. We can rephrase this term and sentence.*

1. “Marginal” household owning 3 to 5 cattle heads presents 1,286 households
2. “Smallholder” household owning 6 to 10 cattle heads presents 413 households
3. “Medium” household owning 11 to 20 cattle heads presents 54 households

For the baseline study, a semi-structured questionnaire was developed to collect quantitative data, while FGD and KII checklists were designed to capture qualitative insights into livestock farming. All data collection tools were carefully tailored to align with the study’s objectives, ensuring a comprehensive and structured approach to data gathering.

A total of 30 enumerators and 5 supervisors were deployed for data collection across the selected districts. The enumerators were trained on the use of the Kobo Toolbox to ensure familiarity with the digital data collection process. Initially, each enumerator was expected to complete four interviews per day, but this was later adjusted to three per day to maintain the quality of responses, given the complexity and length of the questionnaire. Supervisors monitored the field teams daily, addressing concerns as they arose and ensuring adherence to data collection protocols. The collected data were securely stored on the Kobo server before being extracted for analysis.

After data extraction, the dataset was processed in MS Access, where data cleaning and consistency checks were conducted before proceeding with the final analysis. The analysis provided a detailed profile of livestock farmers, covering key areas such as: animal data structures, the productivity of milk (cow) and meat (cattle and goat), feeding grazing practices, livestock mortality, animal health and veterinary services, artificial insemination, market access and trade, financial services and access to credit, improved management practices, manure management, capacity building of farmers etc. including addressing the key learning questions. Additionally, the analysis examined the relationship between livestock productivity, household income, and greenhouse gas emissions using regression analysis.

2.8 NON-RESPONSE AND STUDY LIMITATIONS

It was anticipated that some respondents might drop out due to their unavailability within any of the specified livestock categories. During the planning phase, it was assumed that a list of respondents would be accessible from local sources such as the Upazila Livestock Office. If this list had been available, an additional 10 percent of respondents would typically be considered, bringing the total sample size to approximately 1,948 (calculated as 1,753 / 0.9), accounting for 175 additional respondents. However, this additional list was not required for this study, as farmers owning 3 to 20 cattle heads were identified during data collection until the target sample size was reached.

During the execution of the field survey, there was a small change in the disaggregation of the sampling across the three household (HH) categories due to the unavailability of the target HHs in the marginal category in some districts. This happened due to political unrest and consecutive flooding during the later part of the surveying in the study areas. The change in the planned and executed samples in the three household categories did not make a major anomaly in the proportional distribution of the samples across the households. The timeline for completing the study is outlined in Annex A2.5.

3. RESULTS AND DISCUSSION

SECTION A: PRODUCTION AND PRODUCTIVITY OF LIVESTOCK FARMERS

3.1 DEMOGRAPHIC AND SOCIO-ECONOMIC PROFILE

3.1.1 HOUSEHOLD COMPOSITION

A total of 7,962 individuals were identified across the 1,753 sampled households, indicating an average family size of 4.5 members. The male-to-female ratio was 51:49. The analysis and results are presented in two matrices based on gender and age group. Within the households, 38 percent of members were classified as dependents (aged 17 and below, or above 60 years), while 62 percent fell into the active labor-potential category (aged 18-60 years) (Table 3.1). The youth group (aged 18-35 years) constituted 28 percent of the sampled population, with nearly equal proportions of males and females.

Table 3.1: Proportion of household members by age groups in 16 project districts (percentage)

Age group (year)	Male	Female	All
<=5	8.8	8.7	8.7
6-17	20.3	20.7	20.6
18-29	19.4	20.2	19.8
30-35	8.1	8.9	8.5
36-60	32.5	34.3	33.3
60+	10.9	7.2	9.1

Table 3.2 presents the gender-wise distribution (male-female ratio) of sampled household members across 16 project districts. The data reveal a relatively balanced male to female ratio, with most districts showing close to 50 percent for both males and females. Notably, Kushtia recorded the lowest male percentage (44 percent) and the highest female percentage (56 percent), while Jhenaidah had the highest male percentage (54 percent) and the lowest female percentage (46 percent). In Bogura and Sirajganj, gender proportions were equal at 50 percent each. Overall, across all districts, the gender ratio stands at 51 percent male and 49 percent female, based on a total sample of 7,962 individuals.

Table 3.2: The male-female ratio of the surveyed households in 16 project districts (percentage)

District	Male	Female
Bogura	50	50
Chuadanga	49	51
Gaibandha	49	51
Jamalpur	50	50
Jashore	51	49

District	Male	Female
Jhenaidah	54	46
Joypurhat	52	48
Kurigram	53	47
Kushtia	44	56
Noagaon	51	49
Natore	54	46
Pabna	51	49
Rajshahi	52	48
Rangpur	51	49
Satkhira	52	48
Sirajganj	50	50
Grand Total	51	49

3.1.2 EDUCATION LEVELS

The study examined the educational status of households involved in cattle-rearing, categorized into marginal, smallholder, and medium households.[18] The findings revealed a generally low level of education among both males and females across all household types. Approximately 32-33 percent of household members in each category had no formal education. However, a larger proportion, about 34 percent, had completed 6-10 years of education, indicating that basic schooling is relatively common among these households. Gender-wise, women were more likely to have completed 6-10 years of education (37 percent) compared to men (31 percent). However, fewer women achieved higher levels of education, with only 10 percent attaining 11+ years of education, compared to 17 percent of men. While basic education is accessible to women, advancing to higher levels remains a challenge compared to men, as also highlighted in KIIs.

Table 3.3: Educational status of surveyed household (as a percentage)

Household category	No formal education	1 – 5 years of formal education	6 – 10 years of formal education	11 + years of formal education	Total
Marginal	33	20	34	13	100
Small	32	20	33	15	100
Medium	31	22	33	14	100
Average	32	20	34	14	100

Table 3.4: Educational status by gender (as percentage)

Gender	No formal education	1 – 5 years of formal education	6 – 10 years of formal education	11 + years of formal education	Total
Female	33	20	37	10	100
Male	32	21	31	17	100
Average	32	20	34	14	100

[18] *Marginal owning 3-5 cattle heads, Smallholders owning 6-10 cattle heads, and Medium owning 11-20 cattle heads.*

Educational disparities were also observed among the 16 project districts (Annex A1: Table 3.1). For instance, the proportion of non-school-attending household members was highest in Jamalpur (49 percent), Kushtia (48 percent), and Chuadanga (41 percent). Conversely, Joypurhat (23 percent) and Jashore (25 percent) had the lowest proportions of non-school-attending members, indicating regional differences in educational access and attainment among the surveyed households.

3.2 INCOME SOURCES AND LEVELS

3.2.1 PRIMARY SOURCES OF INCOME

The study revealed that among the 1,753 surveyed households, 11.2 percent are directly involved in livestock-related activities as their main source of income, primarily through cattle rearing (9.2 percent) and fodder cultivation (1.3 percent). These activities are crucial for households who directly depend on livestock for their livelihoods. Furthermore, a substantial 40.5 percent of households rely on farming (36.6 percent) other than fodder cultivation, such as providing straw and other crop byproducts to livestock sharecropping (3.9 percent) and agricultural day labor (14.4 percent), highlighting that a significant portion of households prioritize the agricultural activities that support the cattle and goat industries.

In contrast, Livestock-related activities are the secondary source of income for 48.3 percent of households. Instead, they mainly depend on non-agricultural income sources, with small-scale trading or business (15.9 percent) and salaried employment (8.3 percent) being the most common. Other significant income sources include rickshaw or van driving (5 percent) and foreign remittances (1.6 percent). This distribution underscores the diverse economic landscape in the region, where households are engaged in both agricultural and non-agricultural ventures. It highlights the need to promote livestock-related activities alongside other income-generating opportunities to enhance household economic stability (Annex A1: Table 3.2).

3.2.2 HOUSEHOLD INCOME LEVEL

Households that rely on livestock as either their primary or secondary source of income typically rear cattle for both milk and meat production. Over the past year, 40 percent of these households reported selling cattle, and at the time of the survey, 66 percent had dairy cattle.

The average household income was BDT 373,784[19], with livestock contributing BDT 160,948, or approximately 43 percent of the total income. Income levels varied across household categories: medium households earned more than smallholders, who, in turn, earned more than marginal households (Table 3.5). Livestock income constituted about 62 percent of the total income in medium households, compared to just 33 percent in marginal households. Income levels also varied across districts, with ten districts earning less than 43 percent of their total income from livestock (Annex A1: Table 3.3).

[19] USD *1 = BDT 119 (Source: Bangladesh Bank, October 24, 2024)*

Table 3.5: Average annual income by household categories

Household categories	Number of HH	Average total income of livestock BDT[20]	Average of total income BDT	Percentage from livestock
Marginal	1,286	98,258	300,614	33
Smallholder	413	275,295	546,016	50
Medium	54	608,880	975,289	62
Average	-	160,948	373,784	43

3.3 LAND AND LIVESTOCK OWNERSHIP

The study reveals land ownership patterns by household category and gender, showing that 83 percent of households own land, including homesteads, with an average of 129 decimals (0.52 hectares)[21] per household. Female land ownership remains notably low, with only 4.3 percent of households owned by women (Annex A1: Table 3.4). This disparity highlights the inequalities in land inheritance and ownership for women in Bangladesh, where cultural norms and legal constraints often restrict their access to land[22]. Marginal households (3–5 cattle heads) have an average landholding of 113 decimals, with female-headed households owning 97 decimals and male-headed households owning 114 decimals. Smallholder households (3–5 cattle heads) hold an average of 154 decimals, with female-headed households at 85 decimals and male-headed households at 157 decimals. Medium households (11-20 cattle heads) have the highest land ownership, averaging 256 decimals, with female-headed households holding 365 decimals and male-headed households 252 decimals.

Table 3.6: Land ownership (in decimal) by household categories (n=1,753)

Household categories	Female-headed	Male-headed	Average
Marginal	97	114	113
Smallholder	85	157	154
Medium	365	252	256
Average	105	130	129

[20] *USD 1 = BDT 119 (Source: Bangladesh Bank, October 24, 2024)*

[21] 247 decimals = 1 hectare

[22] https://doi.org/10.1177/21582440241227705 (*A study by the World Bank's Bangladesh Integrated Household Survey (BIHS), only around 10 percent of women in Bangladesh own land, demonstrating a significant disparity in land ownership compared to men, largely due to prevailing cultural norms and limitations within the legal framework that often restrict women's access to land inheritance and ownership).*

3.4 HOUSEHOLD AND ANIMAL DATA STRUCTURE

3.4.1: HOUSEHOLD CATEGORY BASED ON CATTLE-REARING

As shown in Figure 3.1, among the 1,753 sampled households, marginal households (owning 3–5 cattle heads) accounted for the majority, with 1,286 households (73 percent). Smallholder households (owning 6–10 cattle heads) comprised 413 households (24 percent), while medium households (owning 11–20 cattle heads) represented just 54 households (3 percent). The average number of cattle per household was 3.4 for marginal households, 7.5 for smallholder households, and 14.3 for medium households (Figure 3.2). In contrast, goat-rearing practices typically involve an average of 4 to 5 goats per household, regardless of the cattle farming category.

Figure 3.1: Household category-wise proportion (in percentage)

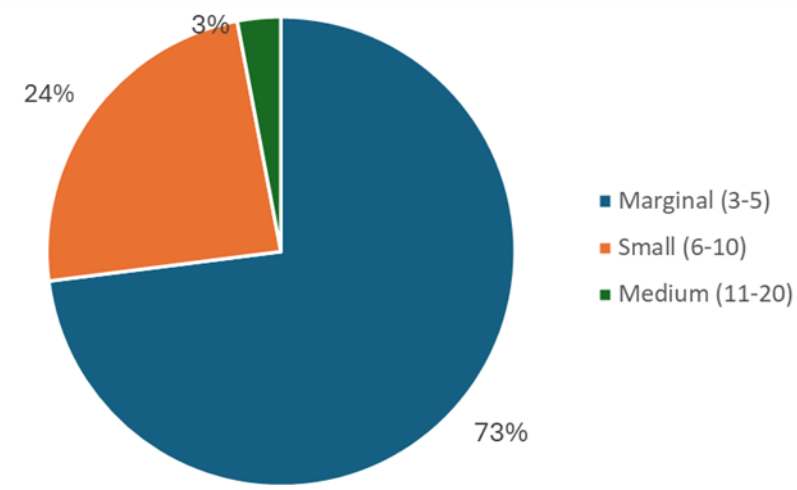
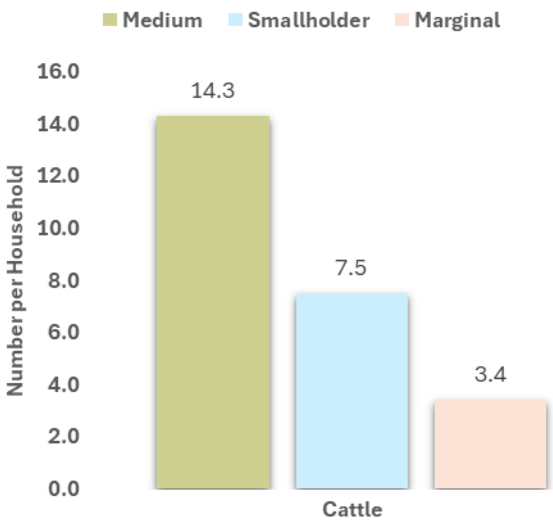


Figure 3.2: Number of cattle per household



The distribution of cattle-rearing responsibilities among household members showed that women are the primary managers in 47.9 percent of households, while men took on this role in 34.2 percent, and joint management occurred in 17.9 percent (Annex A1: Table 3.5).

3.4.2: HOUSEHOLD CATEGORY-WISE NUMBER OF CATTLE AND GOAT

The baseline survey reported a total of 12,007 animals, comprising 8,199 cattle and 3,808 goats across 1,753 households (Table 3.7). The distribution of cattle was 53 percent in marginal households, 38 percent in smallholder households, and 9 percent in medium households. For goats, the distribution was 73 percent in marginal households, 24 percent in smallholder households, and 3 percent in medium households.

Table 3.7: Household-wise number and proportion (as a percentage) of cattle and goats

Household categories	Cattle		Goat	
	Number	Percentage	Number	Percentage
Marginal	4,350	53	2,790	73
Smallholder	3,078	38	902	24
Medium	771	9	116	3
All	8,199	100	3,808	100

When considering the total number of ruminants (cattle and goats) within each household category, cattle accounted for 61 percent of the livestock in marginal households, 77 percent in smallholder households, and 87 percent in medium households. Besides, the goat accounted for 39.1 percent of marginal households, 22.7 percent of smallholder households, and 13.1 percent of medium households. This indicates a tendency for marginal households to focus more on goat rearing (Table: 3.8).

Table 3.8: Percentage of ruminants (cattle and goats) within each household category

Household category	Ruminants	Cattle		Goat	
	(cattle+goat)	Number	Percentage	Number	Percentage
Marginal	7,140	4,350	60.9	2,790	39.1
Smallholder	3,980	3,078	77.3	902	22.7
Medium	887	771	86.9	116	13.1

3.4.3: DATA FOR MILK AND MEAT PRODUCTIVITY

The supplementary survey of 467 households, selected from the 1,753 detailed survey households, aimed to collect detailed information for estimating the milk and meat productivity as well as the relationship between greenhouse gas emissions and milk and meat productivity across different livestock-rearing farmers' categories. The findings revealed a total of 408 dairy cattle, of which 56 percent were crossbred and 44 percent were local breeds. Additionally, 281 bulls were recorded, with 62 percent identified as crossbred. Among 566 goats, only 22 percent were crossbred. This highlights a significant adoption of crossbred cattle for both dairy and beef production, whereas the adoption of crossbred (goat) remains relatively low. Historically, the crossbreeding program informally started in

cattle in Bangladesh with crossing between local indica-type (*Bos indica*) and phenotypically improved local races. Currently, semen of *Bos taurus* such as Holstein Friesian is used in almost 95 percent cases, the rest comes from Shahiwal, Sindhi and Jersey (based on Expert consultation, March 24, 2025, at ACDI/VOCA office). For goat, the local Black Bengal breed is crossed with Jamunapari to produce crossbreds.

However, across household categories, marginal households owned 54 percent crossbreed and 46 percent local breed cows for milk production. Smallholder households had a higher proportion of crossbred (60 percent) compared to local breeds (40 percent), while medium households owned 53 percent of crossbred and 47 percent of local breed cows. This trend suggests that smallholder households were more inclined to own crossbreed cows for milk production (Table 3.9).

Table 3.9: Dairy cows per household categories and breed type (n=408)

Household category	Number of dairy cows	Crossbred (percent)	Local (percent)
Marginal	212	54	46
Smallholder	164	60	40
Medium	32	53	47
Average	-	56	44

For meat production, all household categories exhibited similar adoption rates of crossbreed and local breeds. Crossbred accounted for 63 percent of cattle among marginal and medium households and 61 percent among smallholder households. Likewise, local breeds constituted 37 percent of marginal and medium households and 39 percent of smallholder households (Table 3.10).

Table 3.10: Beef cattle per household categories and breed types (n=281)

Household categories	Number of beef cattle	Crossbred (percent)	Local (percent)
Marginal	161	63	37
Smallholder	101	61	39
Medium	19	63	37
Average	-	62	38

In contrast, goat meat production primarily relied on local breeds across all household categories. Medium households exclusively raised local breed goats (100 percent) for meat production, while smallholder and marginal households had 94 percent and 71 percent local breeds, respectively. Crossbred goat production was minimal, accounting for 29 percent among marginal households and 6 percent among smallholder households, with no crossbreed goats recorded in medium households for meat production (Table 3.11).

Table 3.11: Meat-producing goat per household categories and breed types (n=566)

Household categories	Meat-producing goat (number)	Crossbred (percent)	Local (percent)
Marginal	400	29	71
Smallholder	158	06	94
Medium	8	0	100
Average	-	22	78

3.5 PRODUCTIVITY OF MILK AND MEAT

3.5.1 MILK PRODUCTIVITY

To evaluate milk and meat productivity, a subsample of 467 households from a total of 1,753 was analyzed. The findings revealed that crossbreed cows (average live weight 214 kgs) produced an average of 7.4 liters of milk per day, significantly higher than the 2.0 liters per day produced by local breed cows (average live weight 176 kg) (Table 3.12). Additionally, crossbreed cows had a longer lactation period of 232 days compared to 187 days for local breeds, leading to a significantly higher total annual milk yield. On average, a crossbreed cow produced 1,746 liters per lactation, while local breed cows yielded only 369 liters per lactation (Table 3.13). Experts in Key Informant Interviews (KII) opined that crossbreed cows typically began lactating earlier, around 24 months of age, compared to local breed cows, which starts lactation at approximately 30 months. It was evident in the study that the variability in milk yield was higher among the crossbreed (7.4±3.4) compared to the local breeds (2.0±1.4). Livestock experts stated that the productivity potential of crossbred depends on the genetic quality of the purebred parents from which the semen is sourced. In Bangladesh, semen from various breeds (mostly Holstein-Friesian and Sahiwal) is used, leading to expected variations in crossbreed performance.

Table 3.12: Milk productivity per cow per day by breed types

Breed types	Milk productivity ± SD[23] (liter)
Crossbred	7.4±3.4
Local	2.0±1.4
Average	5.1±4.1

Table 3.13: Milk productivity per cow per lactation by breed types

Breed types	Milk productivity ± SD (liter)
Crossbred	1,746±1,009
Local	369±248
Average	1,164±1,038

[23] *SD= Standard Deviation*

According to the Department of Livestock Services (DLS), the Government of Bangladesh has prioritized crossbreeding programs as a key strategy to boost national milk production and productivity. To support this effort, the DLS, along with private companies, supplies farmers with high-yielding crossbred cattle semen, enhancing livestock productivity. This initiative has led to higher milk yields from crossbred compared to local breeds, aligning with the country's dairy production targets.

However, insights from Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) indicated that local breeds remain a viable option for many small-scale farmers due to their affordability, resilience, and lower management costs. Local-breed calves are more affordable, priced between BDT 40,000–50,000, compared to crossbreed calves, which range from BDT 70,000–80,000. Additionally, milk from local breeds often commands a higher market price due to its higher fat content and richer taste, providing a comparative economic advantage for farmers. Beyond cost considerations, local breeds are well adapted to the local environment, requiring minimal veterinary care and feeding inputs, making them a low-maintenance and cost-effective option. As highlighted in KIIs, local breeds exhibit strong tolerance to heat stress and diseases while efficiently utilizing low-quality forage. This resilience reduces farmers' reliance on expensive feed and veterinary services, further enhancing their economic viability.

Moreover, cultural and consumer preferences significantly influence breed selection. The FGD exercises revealed that milk and meat from local breeds are often perceived as tastier and more nutritious, sometimes commanding higher market prices than crossbred products. In contrast, crossbred require higher investments in feeding, veterinary care, and housing, increasing their overall cost of ownership. While crossbred yield more milk, they are prone to metabolic stress and require nutrient-rich diets, which many small-scale farmers—who primarily rely on natural grazing and green fodder—struggle to provide. As a result, despite their higher productivity, crossbreeds are often less viable for small-scale farmers due to the intensive resource requirements needed for their maintenance.

To balance productivity with adaptability, many farmers have adopted a selective breeding strategy rather than fully transitioning to crossbred. The experts who participated in the KII stated that an increasing number of farmers use Artificial Insemination (AI) with crossbreed semen to gradually enhance milk yields while preserving the resilience of local breeds. This approach enables farmers to improve productivity without bearing the full costs and management challenges associated with purebred animals. By leveraging the strengths of both breeds, this strategy supports sustainable livestock development, allowing farmers to achieve higher milk yields while maintaining disease resistance and adaptability to local conditions.

Milk production and productivity per cow during the lactation period varied by household category, following the order of medium households (1,392 liters) > smallholder households (1,238 liters) > marginal households (1,070 liters). However, the differences in overall milk production or productivity between household categories were not statistically significant (Table 3.14).

Among crossbred, medium households achieved the highest annual milk production per cow at 2,290 liters (averaging 9.52 liters per day), followed by smallholder households with 1,770 liters (7.41 liters per day) and marginal households with 1,640 liters (7.01 liters per day).

Table 3.14: Milk productivity per cow per lactation by breed types

Breed types	Milk productivity ± SD (liter)			
	Marginal	Small	Medium	Average
Crossbred	1,643±920	1,770±1072	2,290±1083	1,746±1,009
Local	350±215	411±304	301±103	369±248
Average	1,070±951	1,238±1084	1,392±1282	1,164±1,038

Table 3.15: Milk productivity per cow per day by breed types

Breed types	Milk productivity ± SD (liter)			
	Marginal	Small	Medium	Average
Crossbred	7.0±3.7	7.4±4.2	9.5±4.2	7.4±4.0
Local	1.8±1.0	2.3±1.9	1.8±0.6	2.0±1.4
Average	4.7±3.8	5.4±4.3	6.0±5.0	5.1±4.1

Table 3.16 presents the average milk productivity per lactation period (in liters per cow) for two breed types — crossbred and local — categorized by the primary role-players in cattle management: male-managed, female-managed, and jointly managed households. Among crossbred, jointly managed households recorded the highest milk productivity, followed by female-managed and male-managed households. In contrast, for local breeds, the variations in milk productivity across male, female, and jointly managed households were minimal, with all categories producing significantly lower yields compared to crossbred.

Table 3.16: Milk productivity per cow per lactation by role players

Breed types	Milk productivity ± SD (liter)			
	Male	Female	Jointly	Average
Crossbred	1,593±1,072	1,780±957	2,083±974	1,746±1,009
Local	329±172	368±267	441±282	369±248
Average	1,140±1,056	1,158±1,018	1,246±1,087	1,164±1,038

Table 3.17 illustrates the daily milk productivity (liters per cow) for crossbred and local breeds, categorized by household management types: male-managed, female-managed, and jointly managed. Among crossbred, jointly managed households achieved the highest yield at approximately 8.7 liters per day, followed by female-managed households at 7.5 liters per day, with male-managed households producing slightly less. In contrast, local breeds exhibited consistently low milk productivity across all management types, with minimal variation, highlighting the higher productivity of crossbred.

Table 3.17: Milk productivity per cow per day by role players

Breed types	Milk productivity ± SD (liter)			
	Male	Female	Jointly	Average
Crossbred	6.7±4.2	7.5±3.8	8.8±4.0	7.4±4.0
Local	1.7±0.9	2.1±1.6	2.2±1.4	2.0±1.4
Average	4.9±4.2	5.1±4.1	5.4±4.4	5.1±4.1

Table 3.18 illustrates the variations in milk productivity (liters per cow per lactation) across 16 project districts, with differences between crossbred and local breeds. Pabna emerged as the leading district, exhibiting the highest productivity for both local and crossbreed cows, with crossbred producing an average of 2,525±708 liters per year. Other districts, such as Noagaon (2,450±1,289 liters), Joypurhat (2,447±776 liters), Sirajganj (2,093±990 liters), and Natore (1,927±715 liters), also demonstrated high milk yields from crossbred. In contrast, local breed productivity remained significantly lower across all districts, with Pabna (1,092±238 liters) being the only district exceeding 1,000 liters. The standard deviation across districts reflects variability, suggesting potential disparities in access to quality breeding, feed, and veterinary services. These findings align with insights from KIIs, which emphasized the importance of breed improvement and enhanced management practices in boosting milk production.

Table 3.18: Milk productivity per cattle per lactation period in 16 project districts

District	Milk productivity ±SD (liter)		
	Crossbred	Local	Average
Bogura	1,095±407	368±198	820±493
Chuadanga	807±225	443±195	547±256
Gaibandha	1,482±602	369±172	626±567
Jamalpur	867±441	407±140	543±334
Jashore	1,522±1,074	375±176	1,007±985
Jhenaidah	1,234±553	334±175	926±629
Joypurhat	2,447±776	470±193	1,927±1,115
Kurigram	1,044±474	223±119	406±417
Kushtia	1,099±686	0±0	1,099±686
Noagaon	2,450±1,289	471±518	1,537±1,412
Natore	1,927±715	380±236	1,394±952
Pabna	2,525±708	1,092±238	2,366±813
Rajshahi	1,238±542	316±90	711±587
Rangpur	1,613±1,389	269±121	1,002±1219
Satkhira	2,562±0	257±77	449±670
Sirajganj	2,093±990	335±182	1,806±1,119
Average	1,746±1,009	369±248	1,164±1,038

3.5.2 CATTLE MEAT PRODUCTIVITY

Table 3.19 illustrates the annual meat production per cattle (as carcass weight) for crossbred and local breeds, with crossbred yielding an average of 107 kg per year, compared to 78 kg for local breeds. Findings from FGDs and KIIs indicate that local breeds are typically slaughtered at around 30 months of age, whereas crossbreds are processed earlier, at approximately 18 months. Additionally, FGD participants stated that local breed calves remain with their mothers for about six months, whereas crossbred calves are weaned earlier, at around three months.

Despite their higher productivity, crossbreds face significant challenges, including higher feed and management costs. In contrast, local breeds require less intensive care, making them easier to manage, as they can subsist on household food waste, straw, and grass. Crossbred, however, require nutrient-rich feed, particularly during periods of feed scarcity, as highlighted in FGDs and KIIs. They are also more susceptible to diseases such as mastitis and parasitic infections, leading to increased management costs due to their lower disease tolerance, as noted in KIIs. Furthermore, inadequate herd health management practices, including limited access to deworming, vaccination, and veterinary services, further constrain productivity.

Table 3.19: Meat productivity (carcass) per cattle per year by breed types

Breed types	Cattle meat productivity ±SD (kg)
Crossbred	107±43
Local	78±36
Average	96±43

Cattle meat productivity was comparable between smallholder and marginal households, both averaging 95 kg annually, while medium households achieved a higher output of 110 kg (Table 3.20). For both local and crossbred, productivity remained similar between smallholder and marginal households.

Among local breeds, medium households produced 69 kg at a rate of 0.19 kg per day, which was lower than the 79 kg produced by smallholder and marginal households, with a daily productivity of 0.22 kg and 0.21 kg respectively. In contrast, for crossbred, medium households outperformed other groups, yielding 134 kg of meat at 0.4 kg per day, compared to 105 kg at 0.3 kg per day for smallholder and marginal households.

Table 3.20: Meat productivity (carcass) per cattle per year by household categories

Breed types	Cattle meat productivity ±SD (kg)			
	Marginal	Small	Medium	Average
Crossbred	105±40	105±43	134±61	107±43
Local	78±30	79±45	69±23	78±36
Average	95±39	95±46	110±60	96±43

Table 3.21 presents annual cattle meat (carcass) productivity by breed type (crossbred and local) and examines variations based on gender roles in cattle management: male-led, female-led, and jointly managed households. Female-led households recorded the highest meat productivity for both breeds, averaging 111 kg per year for crossbred and 86 kg per year for local breeds. Jointly managed households exhibited greater variability, indicating inconsistencies in production levels. Although female-led households showed slightly higher productivity, the differences among the three management categories were not evident.

Table 3.21: Meat productivity (carcass) per cattle per year by major role players

Breed types	Cattle meat productivity ±SD (kg)			
	Male	Female	Jointly	Average
Crossbred	101±40	111±45	109±43	107±43
Local	74±34	86±35	64±41	78±36
Average	90±40	102±43	90±47	96±43

In rural areas, women predominantly manage daily livestock care tasks such as feeding, cleaning, and monitoring animal health, resulting in more consistent and attentive management. This dedicated care enhances crossbred growth and productivity by ensuring proper feeding schedules, hygiene, and timely health interventions, as highlighted in the FGDs exercise. Experts in KIIs emphasized that improving women's access to livestock services and addressing cultural barriers could further enhance livestock production and service delivery outcomes.

Cattle meat productivity varied across the 16 project districts, with Chuadanga, Kushtia, Pabna, and Satkhira showing relatively higher production levels (Table 3.22). However, within each district, productivity exhibited variability (as indicated by the standard deviation). Despite these intra-district differences, regional variations in productivity were largely insignificant.

Table 3.22: Meat productivity (carcass) per cattle per year in 16 project districts

District	Cattle meat productivity ±SD (kg)		Average
	Crossbred	Local	
Bogura	80±24	81±16	80±21
Chuadanga	130±67	110±30	123±58
Gaibandha	68±4	77±18	72±11
Jamalpur	92±37	78±27	81±29
Jashore	106±30	90±43	98±37
Jhenaidah	102±23	83±19	98±23
Joypurhat	67±25	69±41	68±28
Kurigram	104±51	58±50	75±54
Kushtia	134±77	-	134±77
Noagaon	112±25	97±28	106±27
Natore	102±18	69±34	92±28
Pabna	137±49	-	137±49
Rajshahi	101±6	72±11	86±17
Rangpur	68±22	75±32	71±26
Satkhira	140±0	52±26	62±38
Sirajganj	107±58	102±34	106±55
Average	107±43	78±36	96±43

3.6 GOAT MEAT PRODUCTIVITY

Table 3.23 depicts annual goat meat production, categorized by breed type (Crossbred and Local). Among the surveyed households, the average annual meat production per goat was 6.5 kg. Crossbred goats exhibited higher productivity, yielding 8.9 kg per year, which was 1.5 times greater than the 5.8 kg produced by local breeds.

Table 3.23: Meat productivity (carcass) per goat per year by breed types

Breed types	Goat meat productivity ±SD (kg)
Crossbred	8.9±3
Local	5.8±2
Average	6.5±2

Goat meat productivity was highest in marginal households, averaging 6.7 kg per goat, compared to 5.9 kg in smallholder households and 6.1 kg in medium households (Table 3.24). Among local breeds, medium households reported the highest productivity, averaging 6.1 kg per goat (16.8 grams per day), while the difference between smallholder and medium households was not evident. Similarly, for crossbred, productivity showed minimal variation between smallholder and medium households, with no available data for marginal households.

Table 3.24: Meat productivity (carcass) per goat per year by household categories

Breed types	Goat meat productivity ±SD (kg)			
	Marginal	Small	Medium	Average
Crossbred	8.9±3	9.2±1	-	8.9±3
Local	5.8±2	5.7±2	6.1±2	5.8±2
Average	6.7±3	5.9±2	6.1±2	6.5±2

Households where both male and female members jointly managed goats achieved higher meat productivity for both local and crossbred compared to those managed solely by either male or female members (Table 3.25). The collaborative efforts in jointly managed households contributed to increased meat yield and overall productivity, highlighting the benefits of shared responsibilities in livestock care.

Table 3.25: Meat productivity (carcass) per goat per year by major role players

Breed types	Goat meat productivity ±SD (kg)			
	Male	Female	Jointly	Average
Crossbred	8.8±3	8.8±3	9.6±4	8.9±3
Local	5.7±2	5.8±2	6.0±2	5.8±2
Average	6.4±2	6.4±2	7.1±3	6.5±2

Table 3.26 presents the variability in goat meat productivity across the 16 project districts, with Jhenaidah, Noagaon, and Rajshahi reporting the highest productivity levels. In Jhenaidah, crossbred yielded approximately 10 kg per goat annually, compared to 8 kg for local breeds. Similar trends were

observed in Noagaon and Rajshahi, where crossbred produced around 10 kg per goat annually, while local breeds averaged approximately 6 kg.

Table 3.26: Meat productivity (carcass) per goat per year in 16 project districts

District	Meat productivity ±SD (kg)		Average
	Crossbred	Local	
Bogura	6.7±2.0	4.6±1.6	5.4±2.0
Chuadanga	7.6±2.5	7.1±1.1	7.2±1.3
Gaibandha	8.7±1.3	6.2±1.7	6.6±1.9
Jamalpur	5.2±0	5.8±1.5	5.8±1.5
Jashore	9.8±2.1	5.5±1.5	6.6±2.5
Jhenaidah	10.9±2.2	5.8±3.2	8.0±3.8
Joypurhat	7.9±3.0	5.4±0.4	6.4±2.3
Kurigram	6.5±1.3	6.0±1.6	6.1±1.5
Kushtia	8.7±1.0	5.3±1.6	5.6±1.9
Noagaon	10.4±3.3	6.3±2.2	6.9±2.8
Natore	9.8±4.2	5.7±2.0	6.9±3.4
Pabna	8.5±1.8	5.7±2.0	6.1±2.2
Rajshahi	10.3±3.5	5.7±1.8	7.3±3.4
Rangpur	8.3±2.1	5.7±1.5	6.1±1.9
Satkhira	4.9±0.4	5.0±1.7	5.0±1.6
Sirajganj	9.9±2.9	5.5±1.4	7.2±3.0
Average	8.9±3.0	5.8±1.8	6.5±2.5

3.7 ANNUAL SALES AND VOLUME OF MILK AND MEAT

A subset of the total sample (n=467) was analyzed to measure the volume and value of milk sales, while 1,753 households were surveyed for cattle and goat meat production. Breed-specific data for goat carcasses was not collected during the baseline survey. Among the surveyed households, 40.7 percent (714 out of 1,753) sold cattle carcasses, 66 percent (309 out of 467) sold milk, and 16.5 percent (290 out of 1,753) sold goat carcasses.

From the sample, cow's milk sales amounted to USD 0.256 million, with a significant share, USD 0.22 million, generated from crossbred, while local breeds contributed USD 0.036 million. The average sales revenue per cow was USD 957 for crossbred and 202 USD for local breeds, while at the household level, the average milk sales revenue stood at USD 828 per household. Furthermore, a total of 588 Metric Tons (MT) of milk were sold, predominantly from crossbred (506 MT), while local breeds provided 82 MT.

A total of 1,611 cattle were sold, comprising 1,047 crossbred and 564 local breeds. Total cattle meat (carcass) sales amounted to USD 0.915 million, with crossbred generating USD 0.664 million and local breeds contributing USD 0.251 million. The total volume of cattle meat (carcass) sales reached 160 metric tons (MT), with crossbred accounting for 116 MT and local breeds for 44 MT. The average sales revenue per cow was USD 634 for crossbred and USD 443 for local breeds, while the annual household-level earnings from cow sales averaged USD 1,123 per household.

A total of 617 goats were sold, generating USD 0.046 million in sales revenue, with an average price of USD 75 per goat. At the household level, annual earnings from goat sales averaged USD 159 per household (290 HH). Additionally, the total volume of goat meat (carcass) sold reached 5 metric tons (MT) (Table 3.27).

Table 3.27: Annual volume and sales of milk and meat by breed types

Breed types	Sales volume (MT)			Annual sales (million USD)		
	Milk	Cattle carcass	Goat carcass	Milk	Cattle carcass	Goat carcass
Crossbred	506	116	-	0.220	0.664	-
Local	82	44	-	0.036	0.251	-
Total	588	160	5	0.256	0.915	0.046

3.8 FEEDING PRACTICES

3.8.1: Feed Consumption

Table 3.28 shows the daily feed consumption of local and crossbred cattle across three categories: green grass, rice straw, and concentrated feed. On average, each cattle consumed 7.1 kg of rice straw, 11.6 kg of green grass, and 1.3 kg of concentrated feed per day. Both breeds had identical rice straw consumption (7.1 kg per day) but crossbred required more green grass (11.9 kg per day) and concentrated feed (1.5 kg per day) compared to local breeds. Overall, crossbred have higher feed requirements due to their larger body size and physiological demands.

Table 3.28: Feed consumption (kg/cattle/day) pattern by breed types

Breed types	Green grass	Rice straw	Concentrate
Local	10.4 ±6.2	7.1 ±3.8	1.2 ±1.5
Crossbred	11.9 ±7.9	7.1 ±4.0	1.5 ±1.8
Average	11.6±6.6	7.1±3.9	1.3±1.2

Table 3.29 presents the average daily feed consumption across three household types: medium, smallholder, and marginal. Marginal households provided the highest amount of green grass, averaging 11.8 kg per day, followed by smallholder households at 11.4 kg per day and medium households at 9.1 kg per day. Similarly, rice straw intake was highest in marginal households (7.4 kg per day), compared to 6.3 kg per day in smallholder households and 6.1 kg per day in medium households. In contrast, concentrated feed consumption was generally lower across all household categories with medium households providing the most (2.0 kg per day), followed by smallholder households (1.5 kg per day) and marginal households (1.2 kg per day).

Table 3.29: Feed consumption (kg/cattle/day) pattern by household categories

Household categories	Green grass	Rice straw	Concentrate
Marginal	11.8±6.8	7.4±4.1	1.2±1.1
Small	11.4±6.2	6.3±3.1	1.5±1.1
Medium	9.1±4.7	6.1±2.4	2.0±2.7
Average	11.6±6.6	7.1±3.9	1.3±1.2

The analyzed data revealed that marginal households prioritized green grass and rice straw as their primary feed, primarily sourced from cultivated land ails. They generally avoided the additional cost of concentrated feed, except before the Eid festival, when they increased its use to enhance beef cattle weight for sale. In contrast, smallholder and medium households adopted a more balanced feeding approach, incorporating slightly more concentrated feed to improve cattle productivity.

Farmers primarily relied on rice straw as the main roughage for their cattle. FGDs and KIIs revealed limited awareness of the benefits of alternative crop residues, such as wheat stover, maize stover, and black gram residue. Experts in KIIs further emphasized that these underutilized feed sources could offer better nutritional value for livestock. Green grass mainly consisted of naturally grown varieties found in ails, along roadsides, and on sporadic fallow land. However, collecting natural grasses remains labor-intensive.

Concentrated feed consisted of rice husk, rice polish, wheat bran, and mustard oil cake. The survey found that 72 percent of farmers provided concentrated feed to their livestock, with only 5 percent using commercially available feed from local markets, typically at a rate of 0.5–2.0 kg per cattle per day. However, in the FGD exercises, the participants stated that marginal households often provided minimal concentrated feed due to its high cost, whereas commercial dairy and beef farmers, prioritizing productivity, tended to use larger quantities.

In a district-wise comparison, Pabna had the highest green grass intake per animal, averaging 16.9 kg per day, followed closely by Kushtia at 15.3 kg per day. In contrast, Satkhira reported the lowest green grass feeding, at 7.3 kg per day. Noagaon recorded the highest rice straw consumption, averaging 11.0 kg per day, whereas Jashore had the lowest at 5.1 kg per day (Table 3.30).

Pabna, Sirajganj, and Kushtia had the highest concentrated feed levels, averaging 2.0 kg per day, while Satkhira, Jashore, Natore, and Joypurhat reported much lower levels, around 1.0 kg per day. According to the FGD participants, Pabna's widespread fodder cultivation was supported by the availability of cultivated land. In contrast, high soil salinity in some areas limited the feasibility of growing fodder or green grass.

Table 3.30: Feed consumption (kg/cattle/day) pattern by types of feeds across 16 districts

District	Green grass	Rice straw	Concentrate
Bogura	11.1±5.1	5.2±2.1	1.6±1.4
Chuadanga	15.8±8.1	9.1±3.8	1.7±0.7
Gaibandha	10.1±6.1	5.8±2.6	1.4±0.7
Jamalpur	13.4±6.1	5.9±2.7	1.7±0.9
Jashore	10.4±5.2	5.1±2.6	0.7±0.8
Jhenaidah	13.2±5.8	5.7±2.2	1.0±1.0
Joypurhat	8.9±3.7	9.5±2.3	1.0±0.6
Kurigram	8.2±3.6	6.6±3.7	1.3±0.6
Kushtia	15.3±7.1	5.8±3.5	2.0±0.7
Noagaon	12.5±7.6	11.0±3.9	1.0±0.8
Natore	14.4±7.0	7.1±2.6	0.6±0.8
Pabna	16.9±11.5	10.9±6.4	2.0±1.7

District	Green grass	Rice straw	Concentrate
Rajshahi	15.0±8.1	8.0±3.9	1.2±0.9
Rangpur	8.1±4.4	6.8±4.3	1.4±0.9
Satkhira	7.3±3.4	5.2±1.4	1.0±1.3
Sirajganj	10.2±3.8	7.1±3.6	2.0±2.0
Average	11.6±6.6	7.1±3.9	1.3±1.2

3.8.2: Feeding practices by household categories and breed types

Stall feeding was the predominant practice for local breeds across all household categories, with 57 percent of marginal households, 66 percent of smallholder households, and 44 percent of medium households adopting this method. Mixed feeding practices, which combine stall feeding and grazing, were most common among medium households (45 percent), followed by marginal households (41 percent) and smallholder households (30 percent). Grazing alone was more prevalent among medium households (11 percent) compared to smallholder (4 percent) and marginal households (2 percent) (Table 3.31).

Table 3.31: Feeding practices of local breed cattle by household categories (as a percentage)

Feeding practices	Marginal	Smallholder	Medium
Grazing	2	4	11
Mixed	41	30	45
Stall feeding	57	66	44

Similar to local breeds, stall feeding was the predominant practice for crossbred across all household categories, with 98 percent of marginal and smallholder households and 97 percent of medium households adopting this method. Grazing and mixed feeding practices were rare for crossbred; grazing was practiced by only 0.4 percent of smallholder households, while mixed feeding was used by only 2 percent of marginal and smallholder households and 3 percent of medium households (Table 3.32).

Table 3.32: Feeding practices of crossbreed cattle by household categories (as a percentage)

Feeding practices	Marginal	Smallholder	Medium
Grazing	0	0.4	0
Mixed	2	2	3
Stall feeding	98	98	97

When grazing was practiced, as highlighted in FGDs, it was limited to short durations of 1–2 hours per day, primarily on communal lands. The grass available for grazing was typically the same as that fed in stalls, consisting mainly of cultivated Napier alongside other high-yield fodder crops such as maize, Jambo grass and grass pea (a pulse crop).

The limited use of grazing was driven by several factors that often necessitated stall feeding. A key constraint was the lack of available grazing land, as intensive cropping up to three cycles per year, left

little space or time for livestock grazing. In drought- and flood-prone areas, grazing opportunities were further restricted during hazard seasons when land was submerged.

Additionally, a shortage of household labor to take cattle to grazing areas was a significant barrier, as women who primarily managed livestock faced cultural restrictions limiting their ability to work outside the home, as highlighted in KIIs.

In regions such as Rajshahi, Natore, Rangpur, and parts of Satkhira, where mango cultivation is prevalent, protecting orchards was a priority. Farmers often grew black gram or other vegetables around the trees and used fencing to safeguard the orchards, effectively preventing livestock from accessing these areas for grazing.

Except for commercial farms, there is little dedicated land for livestock grazing, as noted by experts in KIIs. They further mentioned that grazing opportunities occasionally arise in certain areas between cropping seasons, where natural grass grows voluntarily. In some charlands (riverine islands), FGD respondents indicated that limited natural grazing opportunities exist. Due to the scarcity of grazing land, most farmers relied on stall feeding, either purchasing fodder from local markets or cultivating grass specifically for livestock feed.

Water availability plays a crucial role in feeding and grazing practices. The participants of the FGD exercise explained that while water sources were generally accessible near stalls, grazing areas often lacked adequate facilities. To compensate, farmers provided water before and after grazing sessions. Additionally, the availability of salt and other minerals was limited, with only a minority of farmers supplementing cattle diets with additives.

3.9 LIVESTOCK MORTALITY

3.9.1: CATTLE MORTALITY

The baseline study reported the death of 198 cows (2.4 percent) out of 8,199 surveyed across different household categories due to various diseases over the past 12 months (Table 3.33). Mortality rates varied by household type, with smallholder households experiencing the highest burden at 2.6 percent (81 out of 3,078 cattle), followed by marginal households at 2.4 percent (103 out of 4,350 cattle) and medium households at 1.8 percent (14 out of 771 cattle).

Table 3.33: Cattle mortality by household categories

Household categories	Number of cattle	Number of cattle died	Percentage
Marginal	4,350	103	2.4
Smallholder	3,078	81	2.6
Medium	771	14	1.8
Total	8,199	198	2.4

The household survey analyzed data revealed that the primary causes of cattle mortality were seizures/anthrax (20.7 percent) and lumpy skin disease (19.7 percent), affecting all household categories but disproportionately impacting marginal and smallholder households. The FGD

participants stated that limited access to vaccinations and inadequate awareness of early disease symptoms often led to delayed treatment, resulting in higher mortality rates. Other significant contributors to livestock loss included birth-related complications (9.6 percent), Peste des Petites Ruminants (PPR) (9.1 percent), bloating (7.1 percent), and diarrhea (6.6 percent). The livestock professionals who participated in the KIIs emphasized that smallholder and marginal households often lacked preventive healthcare measures and timely disease control interventions, leading to increased mortality. In contrast, medium-scale households were more likely to invest in preventive healthcare, including deworming and regular veterinary check-ups, which helped mitigate disease incidence and reduce livestock losses.

Table 3.34: Disease-specific cattle mortality

Disease	Reported	Percentage
Seizures / Anthrax	41	20.7
Lumpy Skin Disease	39	19.7
Other	20	10.0
Died at birth	19	9.6
Peste des Petites Ruminant (PPR)	18	9.1
Bloating	14	7.1
Diarrhea	13	6.6
Foot and Mouth Disease	8	4.0
Pneumonia	8	4.0
Ephemeral fever	5	2.5
Hemorrhagic septicemia	4	2.0
Tetanus	3	1.6
Cow pox	2	1.1
Milk fever (only for dairy cattle)	1	0.5
Prolapse of uterus	1	0.5
Rabies	1	0.5
Retained placenta	1	0.5
Total	198	100

3.9.2: Calf Mortality

Calf mortality emerged as a major concern alongside adult cattle deaths. Among 1,221 calves, 64 fatalities were recorded over the past 12 months, resulting in a mortality rate of 5.2 percent. During the FGDs exercise, the participants identified Lumpy Skin Disease (LSD) as the leading cause of these deaths. Nearly half (48 percent) of the mortalities occurred in calves aged 1–3 months, making this the most vulnerable age group. An additional 30 percent of deaths were reported in calves aged 4–6 months, while the remaining 22 percent occurred in calves aged 6-11 month. The districts of Bogura, Noagaon, Rajshahi, Satkhira, Sirajganj, Jamalpur, and Rangpur recorded relatively high mortality rates, with six to nine deaths reported in each.

The KIIs and FGDs participants emphasized that the high mortality rate among calves aged 1–3 months highlights the significant risks they face, primarily due to inadequate management practices and limited access to veterinary services during this critical developmental stage. To reduce calf mortality,

interventions should prioritize colostrum intake practices, early calf care, improved nutrition, effective disease prevention, and timely veterinary support.

Table 3.35: Calf mortality in the last 12 months in 16 project districts

District	1-3 months	4-6 months	6-11 months	Total
Bogura	5	1	0	6
Gaibandha	0	2	0	2
Jamalpur	2	3	3	8
Jashore	1	1	2	4
Jhenaidah	0	1	0	1
Kurigram	3	1	0	4
Noagaon	4	2	0	6
Natore	0	0	1	1
Pabna	2	0	1	3
Rajshahi	3	2	1	6
Rangpur	4	3	2	9
Satkhira	2	2	3	7
Sirajganj	5	1	1	7
Total	31	19	14	64

3.10 ANIMAL HEALTH AND VETERINARY SERVICES

3.10.1: Vaccination Coverage and Access to Livestock Services

Vaccination is one of the strategies for improving livestock productivity. The study revealed that only 4.7 percent of the total livestock population (cattle and goats) had been vaccinated in the past 12 months. Among the surveyed households (467 samples), 46 percent reported vaccinating at least one animal. Specifically, out of 6,045 cattle, only 363 (6 percent) received vaccinations, indicating low coverage across districts. Jashore recorded the highest vaccination rate among cattle at 10.8 percent, while Kushtia had the lowest at just 0.9 percent (Table 3.36).

Vaccination rates among goats were even lower, with only 48 out of 2,747 (1.7 percent) receiving vaccinations. Several districts, including Gaibandha, Jhenaidah, Joypurhat, Kurigram, and Rangpur, reported no goat vaccinations. Meanwhile, Bogura and Jashore had the highest rates at 4.3 percent and 4.1 percent, respectively.

Table 3.36: Vaccination status of cattle and goats in 16 districts (n=467)

District	Cattle			Goat		
	Number of cattle	Vaccinated	Percentage	Number of goats	Vaccinated	Percentage
Bogura	642	56	8.7	233	10	4.3
Chuadanga	196	3	1.5	164	3	1.8
Gaibandha	231	8	3.5	86	0	0.0

District	Cattle			Goat		
	Number of cattle	Vaccinated	Percentage	Number of goats	Vaccinated	Percentage
Jamalpur	416	12	2.9	157	1	0.6
Jashore	535	58	10.8	290	12	4.1
Jhenaidah	288	21	7.3	70	0	0.0
Joypurhat	169	24	14.2	95	0	0.0
Kurigram	490	22	4.5	198	0	0.0
Kushtia	106	1	0.9	112	4	3.6
Noagaon	494	22	4.5	241	1	0.4
Natore	423	25	5.9	201	4	2.0
Pabna	383	13	3.4	224	3	1.3
Rajshahi	302	19	6.3	216	3	1.4
Rangpur	458	12	2.6	178	0	0.0
Satkhira	294	13	4.4	167	3	1.8
Sirajganj	618	54	8.7	115	4	3.5
	6,045	363	6.0	2,747	48	1.7

By household category, marginal households had the highest proportion of vaccinated livestock, accounting for 5.1 percent of vaccinated animals. Smallholder households followed with 4.1 percent, while medium households reported the lowest vaccination rate at just 2.7 percent.

Table 3.37: Vaccination status of animals by household categories (n=467)

Household categories	Number of animals	Vaccinated animals	Percentage of total animals
Marginal	5,608	288	5.1
Small	2,666	109	4.1
Medium	518	14	2.7

Findings from FGDs indicated that Producer Groups (PGs) received various livestock services, including vaccination, training, deworming, and fodder cultivation guidance, through NGO and government initiatives. Regular training sessions enabled PG members to adopt improved livestock management practices more effectively. However, individual farmers who were not part of an affiliated group or association often had limited access to these services due to their exclusion from structured farmer networks. KII participants emphasized the need to expand outreach efforts, ensuring that individual farmers are integrated into affiliated farmer groups or organizations to gain equitable access to skill development and livestock services.

3.10.2 Challenges in Veterinary Services

According to KII and FGD participants, veterinary services faced major challenges related to availability, affordability, and sustainability, exacerbated by a critical shortage of Local Service Providers (LSPs), particularly female LSPs. LSPs trained by the Department of Livestock Services (DLS), private companies, and NGOs played a crucial role in delivering livestock healthcare. However, many struggled to sustain their services after project funding ended due to insufficient institutional support, lack of coordination, logistics support, and financial constraints.

FGDs highlighted a critical gap in the low participation of women as LSPs, despite their growing involvement in livestock rearing. Cultural norms, mobility restrictions, and limited access to skill development and logistics opportunities were key barriers preventing women from entering veterinary service roles.

Meanwhile, self-initiated LSPs those who pursued independent training and built direct relationships with farmers were able to sustain their work by diversifying their services. Many supplemented their veterinary practice with the sale of medicines and livestock supplies, enabling them to expand both their income and client base.

3.10.3 Barriers to Preventive Livestock Healthcare

LSPs participating in the FGDs observed that household spending on veterinary services had increased in recent years. However, many farmers remained reluctant to invest in preventive healthcare, such as vaccinations and routine check-ups, primarily due to high costs associated with veterinary visits and medicines. Additionally, government veterinarians often charged fees comparable to those of private practitioners, further limiting accessibility. FGDs also revealed that most farmers prioritized treatment only when their animals were ill, rather than proactively investing in regular preventive care.

Livestock experts identified vaccine shortages, inadequate veterinary services, and low farmer awareness as key challenges hindering vaccination coverage and disease prevention. They emphasized the need for improved vaccine distribution, strengthened veterinary service networks, and expanded farmers' literacy and awareness creation programs.

To address these issues, project efforts should focus on supporting LSPs, extending outreach to independent farmers, and promoting preventive healthcare through targeted awareness campaigns. Effective collaboration between government departments, NGOs, private companies and local service providers will be essential to ensuring affordable and sustainable veterinary services for all farmers.

3.11 ARTIFICIAL INSEMINATIONS (AI)

Artificial Insemination (AI) is one of the strategies for improving livestock productivity. The baseline study observed that 65 percent of respondents (1,147 households) had accessed Artificial Insemination (AI) services in the past 12 months, indicating its widespread adoption among livestock farmers. Among these households, 59.7 percent used AI to inseminate purebred semen (mostly Holstein-Friesian and Shahiwal) for crossbreeding, 27.6 percent for local breeds, and 12.6 percent for both. These findings reflect a strong preference for crossbreeding, driven by the higher milk and meat production potential of crossbred livestock.

KIIs and FGDs provided deeper insights into farmers' breeding preferences. Holstein Friesian semen, used by 47 percent of households, dominated the livestock population due to its high milk yield and strong adaptability to AI practices. This was followed by Shahiwal (23 percent) and Australian breeds (13 percent), which were favored for their moderate milk production and relatively better resilience to local conditions. In contrast, Jersey-Sindhi breeds (4 percent) and other breeds (13 percent) were less preferred due to lower demand for their milk productivity and challenges in adapting to the regional environment.

Local cattle breeds exhibited a higher success rate in conception on the first attempt, achieving 60 percent, compared to crossbred, which had a lower first-attempt success rate of 46 percent. Among crossbred, 37 percent required a second attempt to achieve conception.

Artificial Insemination (AI) services were delivered by various organizations, with BRAC Dairy being the leading provider, serving 46.4 percent of households. This was followed by ACI (22.5 percent) and the Department of Livestock Services (DLS) (15.7 percent). Other providers included American Dairy, Ejab, and Laal Teer (Table 3.38).

Table 3.38: Artificial Insemination service received from the different types of service providers

Service providers	Percentage of households that received services
Laal Teer	4.5
Ejab	4.8
American Dairy	6.1
DLS	15.7
ACI	22.5
BRAC Dairy	46.4

According to the Department of Livestock Services (DLS), despite the recent increase in AI technicians and service providers, a significant shortage remains. In areas where market demand for crossbred dairy and rearing cows is low, the expansion of AI services has been limited. Farmers in these regions primarily rely on a small number of government-run animal hospitals and veterinary doctors, and in many cases, AI services are scarcely utilized.

In certain areas, particularly the Charland (riverine islands) of Kurigram and Gaibandha, instances of inexperienced AI workers improperly administering artificial insemination have resulted in the death of cows. These incidents have undermined farmers' confidence in AI services, further limiting adoption in these regions.

The KIIs participants highlighted a notable increase in the number of AI service providers, both from governmental and non-governmental organizations, in recent years. Additionally, semen companies actively promote their brands through AI technicians who serve local markets, while organizations like BRAC deploy AI technicians in villages and ensure their contact details are readily accessible to farmers.

Qualitative insights from FGDs and KIIs revealed that both government and non-government entities expressed their commitment to strengthening support for AI service providers by enhancing resource allocation and logistical support. As part of this initiative, the government’s Upazila Livestock Office has taken proactive measures to recruit additional extension agents with specialized AI expertise, aiming to improve farmer support and expand service availability.

Farmers rated their satisfaction with AI services on a scale of one to five, with one being the lowest and five the highest. The majority (63.2 percent) reported above-average satisfaction, while 22.9 percent indicated an average experience. However, 13.9 percent rated their experience below average, citing key concerns such as poor-quality semen, delivery delays, expired or undeveloped

semen, and inadequately trained livestock service providers, all of which reduced AI effectiveness. Livestock experts emphasized that addressing these challenges through improved semen quality, streamlined service delivery, and enhanced training for AI technicians can significantly boost AI adoption and enhance livestock productivity across the project areas.

3.12 MARKET ACCESS AND TRADE

Quantitative data from household surveys, combined with qualitative insights from KIIs and FGDs, underscored the critical role of market access and trade in shaping the livelihoods of livestock farmers across the surveyed districts in Bangladesh. However, livestock products such as milk and meat faced significant market challenges due to reliance on informal sales channels and infrastructural limitations.

Milk sales

The survey found that 309 out of 467 households engaged in milk sales. Among them, 68.9 percent sold milk to *Goalas* (street milk vendors), followed by 54.4 percent at local markets and 52.8 percent to neighbors. In contrast, formal sales channels were less utilized, with only 14.2 percent selling to dairy companies, 2.3 percent to urban markets, and a mere 0.3 percent at the farmgate. While informal channels offered convenience, FGDs highlighted concerns regarding inconsistent pricing, underpayment, and a lack of quality control, affecting farmers' profitability and market stability.

Table 3.39: Percentage of households sold milk to milk selling points (Multiple responses)

Selling Points	Percentage of household
Goala/ Sweet Maker	68.9
Local Market	54.4
Neighbor	52.8
Dairy company	14.2
Urban market	2.3
Farmgate	0.3

Live animal trade

The household survey data revealed that 714 out of 1,753 households sold livestock in the past 12 months. Data indicated that local markets were the primary sales channel, accounting for 86 percent of cattle transactions, while only 8 percent of sales occurred in urban markets and 6 percent at the farm gate.

For goats, FGD participants highlighted that most transactions took place either at the farmgate or in local markets, reflecting farmers' preference for accessible and informal sales networks. However, reliance on these traditional channels often resulted in pricing fluctuations and limited bargaining power for sellers.

Table 3.40: Percentage of households sold animals to selling points (multiple responses)

Selling points	Percentage of household
Local market	86
Urban market	7
Farmgate	6
In the village	1

The data underscored significant inefficiencies in livestock market access, with informal sales channels dominating both the milk and meat trade. While these channels offered convenience, they also contributed to economic inefficiencies, including lower prices for farmers and restricted access to quality-conscious buyers. These challenges were further exacerbated by the lack of cooling and chilling stations in the surveyed districts, limiting milk storage and reducing marketability. Similarly, the meat trade suffered from a fragmented market system and heavy reliance on intermediaries, which eroded farmers' profit margins, as highlighted in FGDs.

KIIs emphasized that limited awareness and inadequate resources to implement food safety measures further restricted farmers' ability to access premium markets. Market access constraints had a direct impact on farmers' income and overall livelihoods, with women facing additional challenges such as restricted mobility and limited direct access to markets. FGDs stressed the need to address gender disparities and enhance farmers' bargaining power in informal markets. For instance, the dominance of *Goalas* in milk sales created income disparities, while the heavy reliance on local cattle markets and minimal engagement in urban markets. This highlighted the need for structured market systems including digital platforms with farmers' accessibility.

KIIs and FGDs emphasized the need for structured market systems by creating an enabling environment where farmers can connect directly with buyers, enhancing their bargaining power and fostering better market integration. Strengthening infrastructure, such as transport networks and cooling stations, is essential to improving the marketability of livestock products and minimizing post-harvest losses. Additionally, the adoption of food safety practices can facilitate access to premium markets, boosting both product value and profitability.

To promote inclusivity, women-responsive training programs can empower women farmers. However, their mobility constraints need to be addressed to enable their active participation. Finally, leveraging digital platforms for price transparency and buyer-seller linkages can reduce reliance on intermediaries, ensuring fairer pricing and increasing farmers' overall income.

3.13 FINANCIAL SERVICES AND ACCESS TO CREDIT

3.13.1: LOAN RECEIVED AND SOURCES

Among the surveyed households, a mere 17.8 percent reported accessing any form of financing, underscoring significant financial exclusion within the livestock sector. Non-Governmental Organizations (NGOs) emerged as the primary source of agricultural lending for livestock farming for 55.6 percent of these respondents, followed by Microfinance Institutions (MFIs) at 41.8 percent, and local money lenders at 2.6 percent. Notably, 77.6 percent of the loans were obtained by women, reflecting NGOs' strategic focus on female borrowers to promote women's empowerment. FGD participants emphasized a preference for informal lending sources due to their accessibility and simplified processes, despite the burden of higher interest rates.

This reliance on informal credit highlights the necessity for more inclusive and affordable financial services tailored to the needs of livestock farmers. Enhancing access to formal financing options could mitigate the challenges posed by high-interest informal loans and support the sustainable growth of the livestock sector.

Table 3.41: Sources of loan by household categories

Loan source	Marginal	Smallholder	Medium	Total	Percentage
Local money lenders	7	1	0	8	2.6
Microfinance institution	104	24	3	131	41.8
NGOs	130	38	6	174	55.6
Total	241	63	9	313	100

Table 3.42 reveals notable disparities in loan access across different household categories and districts. Medium households secured the highest average loan amounts, receiving BDT 261,111 with a standard deviation of BDT 212,923. In contrast, smallholder households obtained an average of 91,429 BDT (±77,182), and marginal households received BDT 73,451 (±79,971), indicating both lower amounts and higher variability in loan access for these groups.

Geographically, Bogura and Pabna districts reported the highest average loan amounts for medium households, with BDT 425,000 (±388,909) and BDT 350,000 (±212,132) respectively. Conversely, districts such as Chuadanga, Jhenaidah, Jamalpur, and Kushtia recorded no loans for medium households. Among smallholders, Kurigram stood out with higher average loans of BDT 222,500 (±148,408), while Jhenaidah reported no loans for this category. For marginal households, Pabna and Natore districts had the highest average loans at BDT 110,708 (±97,761) and BDT 109,545 (±81,867) respectively, whereas Kushtia had the lowest at BDT 38,571 (±17,728).

Table 3.42: Average loan amount (BDT) with standard deviation by districts and household categories

District	Marginal	Smallholder	Medium	Average
Bogura	57,000±58,770	92,333±35,223	425,000±388,909	96,500±139,900
Chuadanga	89,000±65,904	30,000±0	0±0	83,636±65,003
Gaibandha	62,857±19,760	95,000±46,547	0±0	74,545±33,871
Jamalpur	46,000±22,694	48,333±20,207	0±0	46,500±21,447
Jashore	77,909±85,499	98,500±2,121	320,000±0	98,143±98,773
Jhenaidah	52,500±34,034	0±0	0±0	52,500±34,034
Joypurhat	102,647±93,108	50,000±0	50,000±0	97,105±89,339
Kurigram	59,412±36,353	222,500±148,408	0±0	90,476±93,098
Kushtia	38,571±17,728	40,000±0	0±0	38,750±16,421
Noagaon	70,679±119,587	80,000±76,616	0±0	71,950±114,011
Natore	109,545±81,867	70,625±30,640	0±0	93,158±66,921
Pabna	110,708±97,761	125,833±139,155	350,000±212,132	128,500±122,790
Rajshahi	43,571±24,553	100,000±0	150,000±0	50,652±33,989
Rangpur	45,333±22,633	89,900±69,026	0±0	65,591±53,162
Satkhira	78,500±69,549	61,000±25,593	0±0	75,000±63,163
Sirajganj	85,667±103,352	74,000±53,198	140,000±84,853	87,955±91,165
Average±SD	73,451±79,971	91,429±77,182	261,111±212,923	82,466±90,914

3.13.2: BARRIERS TO ACCESS LOAN

Table 3.43 outlines the barriers households face in accessing loans. The most significant obstacle is high interest rates, affecting 28.8 percent of the 313 households surveyed. A lack of information or awareness about available financial services impacts 11.8 percent of households, while 3.2 percent encounter challenges due to insufficient collateral. Complex application processes deter 2.9 percent of potential borrowers, and 1.6 percent are affected by the limited presence of financial institutions in their area. These findings highlight the need for more accessible, transparent, and supportive financial services to address the diverse challenges faced by households seeking loans.

These challenges are further exacerbated by financial institutions' limited understanding of the unique needs of livestock farmers, as well as the farmers' low financial literacy levels. This disconnect often results in financial products that are not tailored to the specific requirements of the livestock sector, thereby hindering farmers' access to essential credit and financial services.

Addressing these barriers necessitates a multifaceted approach. Financial institutions should develop customized loan products that consider the unique cash flow patterns and asset structures of livestock farming. Simultaneously, enhancing financial literacy among farmers through targeted financial literacy programs can empower them to navigate financial systems more effectively. Expanding the reach of financial institutions into rural areas, simplifying loan application procedures, and reassessing collateral requirements can also play pivotal roles in improving financial inclusion for livestock farmers in Bangladesh.

The FGD participants opined that geographic dispersion and vulnerability, such as floods and cyclones, also significantly hinder smallholder farmers' access to formal financial services. Remote farming communities, coupled with inadequate infrastructure, limit financial institutions' presence, restricting smallholders' engagement with banking systems.

Additionally, in accessing agricultural lending from formal banking sources, financial institutions often have strict credit requirements, such as collateral security, which small and marginal farmers find difficult to meet. Consequently, larger commercial farmers are often prioritized, marginalizing smallholders. Addressing these issues necessitates developing customized loan products, expanding rural financial services through decentralized digital banking channels, and integrating risk assessments to build resilience among smallholder farmers.

Table 3.43 Barriers to accessing the loan

Barriers	No. of households	Percentage
Complex application process	9	2.9
High interest rates	90	28.8
Insufficient collateral	10	3.2
Lack of information or awareness	37	11.8
Limited Financial Institutions in the Area	5	1.6

3.13.3: UTILIZATION OF LOANS

Table 3.44 details the various purposes for which households have taken loans, highlighting a strong focus on livestock-related activities. The majority of households, 62.9 percent, utilized loans for beef fattening, indicating a significant investment in cattle rearing for meat production. Additionally, 50.5 percent of households directed funds towards increasing cow's milk production, emphasizing the importance of dairy farming. Goat fattening was also a notable purpose, with 18.2 percent of households engaging in this activity.

Beyond livestock, 19.8 percent of households allocated loans to agricultural farming, reflecting a commitment to crop cultivation. Smaller percentages of loans were used for ventures such as small businesses (2.2 percent) and fish farming or pond aquaculture (1.3 percent), indicating diversification into non-livestock enterprises. A portion of households, 5.4 percent, utilized loans for family expenses, suggesting the role of credit in meeting immediate household needs.

Challenges contributing to this outcome included inadequate loan sizes and poor financial planning, often exacerbated by low financial literacy, as highlighted in FGDs. These figures underscore the critical role of loans in enhancing livestock productivity and supporting agricultural activities among households. The data also highlights efforts toward economic diversification and the use of credit to address both business and personal financial requirements.

Table 3.44: Purpose of loan taking

Purpose	Number of households	Percentage of households
Beef fattening	197	62.9
Goat fattening	57	18.2
Increase in production of cow's milk	158	50.5
Agricultural farming	62	19.8
Small business	7	2.2
Fish farming (pond aquaculture)	4	1.3
Family expenses	17	5.4
Other livestock-rearing purposes	11	3.5

3.13.4: SATISFACTION WITH FINANCIAL SERVICES

While 40 percent of households expressed satisfaction with financial services, a significant 60 percent reported dissatisfaction, citing high interest rates, inadequate customer support, and a lack of transparency in loan terms. Key Informant Interviews (KIIs) revealed that many farmers are unaware of alternative financial products offering more affordable rates and better terms. This lack of awareness contributes to mistrust and reluctance to engage with financial institutions. Building trust and transparency in financial services is critical to increasing adoption among smallholders. Addressing these issues requires financial institutions to develop tailored products that align with smallholders' needs and to implement comprehensive financial literacy programs. Such initiatives can empower farmers to make informed decisions, fostering greater trust and engagement with formal financial systems.

3.14 IMPROVED LIVESTOCK MANAGEMENT PRACTICES

Fodder management has been recognized as a vital adaptive farming practice that supports animal health, particularly during periods of green grass scarcity (Islam et al., 2021; BLRI, 2023). The availability of high-quality fodder plays a crucial role in sustaining livestock productivity, reducing reliance on expensive commercial feed, and enhancing resilience to variability (Ahamed et al., 2024).

The baseline study found that among the 467 sub-sampled households from a total of 1,753, 198 households (42 percent) cultivated Napier grass as fodder. Of these, 94 percent utilized their own agricultural land, while only 6 percent leased land from neighboring farmers for cultivation. Table 3.45 shows that on average, fodder-cultivating households allocated 0.033 hectares for cultivation, with variations across household categories. Medium-scale households allocated more land (0.04 ± 0.9 ha) compared to smallholder (0.03 ± 0.05 ha) and marginal households (0.03 ± 0.03 ha). Notably, 83 percent of households that leased land for fodder cultivation belonged to the marginal category, highlighting their limited land ownership and greater dependency on external land resources for livestock feed production.

Table 3.45: Average land used for fodder cultivation by household category

Household categories	Fodder cultivation area ±SD (ha)
Marginal	0.03±0.03
Smallholder	0.03±0.05
Medium	0.04±0.9

Table 3.46 presents the average land area dedicated to fodder cultivation across all 16 project districts. Notably, Sirajganj district exhibits a higher average land allocation for fodder cultivation, with 0.09 hectares per household, indicating a significant commitment to livestock feed production. Similarly, Joypurhat district shows a substantial average of 0.09 hectares per household. In contrast, districts like Gaibandha and Kurigram have lower averages, at 0.01 hectares per household, suggesting limited land resources allocated for fodder cultivation.

KIIs with agricultural experts identified several issues for the low adoption rate of fodder cultivation, such as limited access to quality fodder seeds, land constraints, seasonal variation, and financial limitations. Farmers in FGDs reported the cost of irrigation and inputs further restricted the expansion of fodder cultivation.

Table 3.46: Average land used for fodder cultivation by districts

District	Number of households (198)	Fodder cultivated land ±SD (ha)
Bogura	26	0.03±0.02
Chuadanga	12	0.02±0.01
Gaibandha	3	0.01±0.00
Jamalpur	7	0.02±0.02
Jashore	29	0.03±0.01
Jhenaidah	21	0.02±0.01
Joypurhat	8	0.09±0.01
Kurigram	1	0.01±0.00
Kushtia	9	0.04±0.03
Noagaon	12	0.02±0.02
Natore	19	0.02±0.01
Pabna	11	0.03±0.02
Rajshahi	3	0.07±0.08
Rangpur	10	0.01±0.01
Satkhira	1	0.13±0.00
Sirajganj	26	0.09±0.11

3.15 CAPACITY BUILDING

Table 3.47 reveals that a mere 6 percent (105 out of 1,753) of surveyed households received training. Participation varied notably across farmer categories: marginal farmers constituted 4 percent (50 out of 1,286 households), smallholder 10 percent (43 out of 413 households), and medium-scale farmers 22 percent (12 out of 54 households). District disparities were evident, with Pabna and Bogura exhibiting the highest training participation rates at 24 percent and 22 percent, respectively. Conversely, districts such as Joypurhat, Jashore, Jhenaidah, and Kurigram reported no training participation. The majority of trained households were engaged in producer groups formed through initiatives by NGOs or the Department of Livestock Services (DLS).

Table 3.47: Training received by household categories in 16 project districts (n=1,753)

District	Marginal	Smallholder	Medium	Total
Bogura	5	17	1	23
Chuadanga	0	0	1	1
Gaibandha	2	2	0	4
Jamalpur	3	0	1	4
Jashore	0	0	0	0
Jhenaidah	0	0	0	0
Joypurhat	0	0	0	0
Kurigram	0	0	0	0
Kushtia	2	1	0	3
Noagaon	3	4	1	8
Natore	2	0	0	2
Pabna	13	9	3	25
Rajshahi	7	4	3	14
Rangpur	1	0	0	1
Satkhira	11	6	1	18
Sirajganj	1	0	1	2
Total	50	43	12	105

Table 3.48 details the training topics received by 105 surveyed households, emphasizing a strong focus on animal husbandry and health. A significant 93.3 percent of participants received training in animal husbandry, underscoring its importance in livestock management. Training in disease prevention and treatment was provided to 70.5 percent of households, highlighting efforts to enhance herd health. Artificial insemination techniques were covered for 64.8 percent, indicating a move towards improving reproductive efficiency. Feed and fodder management training reached 54.3 percent, essential for optimizing nutrition. Deworming practices were addressed by 49.5 percent of households, aiming to control parasitic infections. Selection of high-yielding cattle breeds was a topic for 39 percent, focusing on genetic improvement. Beef fattening strategies were shared with 32.4 percent, targeting meat production enhancement.

Improving farm environment and cow dung management were discussed with 21.9 percent, promoting hygiene and sustainability. Proper milking procedures were taught to 16.2 percent, ensuring milk quality and udder health. Farm management aspects, including cowshed maintenance and water supply, were covered by 14.3 percent. Care for newborn calves was included for 12.4 percent, vital for early-life survival. Inoculation practices were introduced to 7.6 percent, focusing on immunization. Hygiene management training reached 4.8 percent, emphasizing cleanliness. Financial planning and income management were discussed with 2.9 percent, aiding economic stability. Animal marketing and silage production were each addressed with 1 percent, and income opportunities for women through dairy products were highlighted for 2 percent, promoting women inclusivity in agribusiness. Farmers were asked to identify their training priorities, and they highlighted cattle selection, shed management, feed management, breed management, and disease management as key areas of focus. They also strongly recommended incorporating practical demonstrations in the training to enhance understanding and application.

Training programs, as highlighted in Key Informant Interviews (KIIs) with DLS officials, were primarily conducted through Veterinary Training Institutes (VTIs) and Institutes of Livestock Science and Technology (ILST) under the Department of Livestock Services (DLS). However, many of these institutions operated at reduced capacity due to limited faculty and inadequate funding. District-level DLS offices operated on insufficient budgets, often limited to one or two short training sessions annually. In addition, the reliance on classroom lectures and printed materials over practical demonstrations and digital learning tools reduced training effectiveness. Women's participation in these programs remained disproportionately low due to cultural norms and a lack of female trainers and Local Service Providers (LSPs), which further limits women-sensitive training opportunities, as noted in FGDs with women farmers.

To bridge existing gaps in livestock training, it is essential to expand programs to underserved regions, diversify training topics, and actively engage women. Enhancing the number of female LSPs can improve household-level access to livestock services, empowering women farmers and fostering women-inclusive growth. A balanced training curriculum and equitable access, as highlighted in KIIs, are pivotal for sustainable development and increased productivity in the livestock sector.

Table 3.48: Types of training received by surveyed households (n=105)

Training topics	Percentage of households
Animal husbandry	93.3
Prevention and treatment of diseases	70.5
Artificial insemination	64.8
Feed and fodder management	54.3
Deworming	49.5
Selection of cattle breed (high-yielding)	39.0
Beef fattening	32.4
Improving farm environment/ cow dung management	21.9
Proper milking procedure	16.2
Farm management (cowshed and water supply)	14.3

Training topics	Percentage of households
Taking care of a newborn calf (sal- milking)	12.4
Inoculation	7.6
Hygiene management	4.8
Income-ways of the financial/business plan	2.9
Animal marketing	1.0
Silage production	1.0
Income for women through dairy products (curd, ghee etc.)	2.0

SECTION B: GREENHOUSE GAS (GHG)

4. GREENHOUSE GAS EMISSIONS IN LIVESTOCK

4.1 BACKGROUND

As described by Fresco et al. (2023), methane (CH_4) is one of the most impactful greenhouse gases contributing to climate change (UNEP, 2021). Agriculture is the primary source of anthropogenic CH_4 emissions (Jia et al., 2019), with approximately 70 percent originating from enteric fermentation—a natural digestive process in ruminants (Nabuurs et al., 2022). Among ruminants, cattle are the largest contributors to CH_4 emissions (Gerber et al., 2013), reducing their enteric CH_4 production.

According to the literature, CH_4 emissions can be expressed in three key units (de Haas et al., 2017): (i) CH_4 production, which measures CH_4 per animal per day or year; (ii) CH_4 intensity, which measures CH_4 per kilogram of output product (milk or meat); and (iii) CH_4 yield, which measures CH_4 per kilogram of Dry Matter Intake (DMI).

CH_4 production per animal primarily reflects individual feed intake and, consequently, the level of milk or meat production. Methane intensity is closely tied to the output of milk or meat and the associated energy requirements. For a given feed, CH_4 yield indicates the methanogenic potential of the digestive process to be evaluated for the project performance. The BCSL project has used CO_2 equivalent CH_4 intensity as the unit of GHG emission, because the project's performance, in this regard, will be evaluated by their unit, specified unit in the Performance Monitoring Plan (PMP).

4.2 METHODOLOGY

This study followed the IPCC guidelines for estimating CH_4 emission in livestock following the Bangladesh Government's updated Nationally Determined Contribution (NDC)[24].

The IPCC guidelines[25] provide methods for estimating emissions (or removals) of each greenhouse gas in mass units, organized into different levels of methodological complexity known as 'Tiers.' In the livestock sector, the Government of Bangladesh has been using "Tier 1" methodology, which is being upgraded to "Tier 2"[26] highlighted by experts of DLS, BLRI and FAO in the stakeholder workshop held on 2nd May 2024 organized by ACDI/VOCA Bangladesh.

The Tier 2 methodology offers a more site-specific and detailed assessment of factors influencing emissions. It accounts for a wide range of variables, such as local climatic conditions, livestock types, and management practices, leading to more precise estimations. This level of detail enables policymakers, researchers, and farmers to make informed decisions about emission reduction strategies and the sustainability of agricultural practices.

[24] *https://unfccc.int/sites/default/files/NDC/2022-06/NDC_submission_20210826revised.pdf*
[25] *IPCC Tier 2 methodology - Assessing agriculture's carbon footprint | Agrecalc*
[26] *Stakeholder workshop on GHG emission measurement technique held on 2nd May 2024 organized by ACDI/VOCA Bangladesh*

In line with the Government's adopted methodology, we used the IPCC Tier 2 methodology, as described in Chapter 10 of the IPCC document Emissions from Livestock and Manure Management[27] .

In the baseline study, GHG emission was estimated as methane emissions. The emissions were calculated for individual animals under three categories - dairy cattle (169 local breeds and 228 crossbred dairy cattle, total 337), beef cattle (106 local breeds and 175 crossbred bulls, total 281), and meat goats (442 local breeds and 124 crossbred non-dairy goats, total 566). The calculations were made through the following equations:

Methane-CO_2e = (EF + Manure-sourced CH_4) x CMCF [Eq. 1]

Methane-CO_2e is CO_2 equivalent of the methane emission of individual animals within the three animal categories (dairy cattle, beef cattle and goats);

EF, the emission factor for enteric CH_4 emission, was estimated using the equations described below.

The value of the **manure-sourced CH_4** emission was considered as 'static' for all animals within the animal categories - 5, 2, and 0.22 units per animal head for dairy cattle, beef cattle and beef goats, respectively.

CMCF is the conversion factor of 1 kg of emitted methane corresponding CO_2; we used a conversion factor of 29.8 kg of CO_2e[28]. This data was sourced from FAOSTAT (FAO, 2017).

EF = [GE x (Y_m / 100) x 365] / 55.65 [Eq. 2]

EF is the emission factor, kg CH4 $head^{-1}$ $year^{-1}$;

GE is the gross energy intake, MJ $head^{-1}$ day^{-1};

Y_m is the methane conversion factor, percent of gross energy in feed converted to methane. In this study, we used the value of Y_m as 6.5, 6.5 and 5.5, respectively, for dairy cattle, beef cattle and goat as per IPCC (2021) guideline; and

55.55 is the factor (MJ kg^{-1} CH_4) of energy content of methane.

GE = [{(NE_m + NE_a + NE_l + NE_w + NE_p) / REM} + (NE_g / REG)] / DE [Eq. 3]

GE is the gross energy, MJ day^{-1};

NE_m is the net energy required by the animal for maintenance, MJ day^{-1} (**Eq. 4**);

NE_a is the net energy for animal activity, MJ day^{-1} (**Eq. 5**);

NE_l is the net energy for lactation, MJ day^{-1} (**Eq. 6**);

NE_w is the net energy for work, MJ day^{-1} (**Eq 7**);

NE_p is the net energy required for pregnancy, MJ day^{-1} (**Eq. 8**]

REM is the ratio of net energy available in a diet for maintenance to digestible energy consumed (**Eq. 9**);

NE_g is the net energy needed for growth, MJ day^{-1} (**Eq. 10**); and

[27] https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch10_Livestock.pdf

[28]IPCC (2021). IPCC Sixth Assessment Report: Climate Change 2021. Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge; cited by Brander and Davis (2023) - https://ecometrica.com/assets/GHGs-CO2-CO2e-and-Carbon-What-Do-These-Mean-v2.1.pdf

REG is the ratio of net energy available for growth in a diet to digestible energy consumed (**Eq. 11**).

DE is the digestibility of feed expressed as a fraction of gross energy (digestible energy / gross energy).

$NE_m = Cf_i \times (Weight)^{0.75}$ [Eq. 4]

NE_m is the net energy required by the animal for maintenance, MJ day^{-1};

Cf_i is the coefficient which varies for each animal category. In this study, we used a value of 0.386, 0.370 and 0.315 for dairy cattle, beef cattle and meat goats, respectively, as per IPCC 2019 guideline.

Weight is the live-weight of animal, kg; it was used as a measured input was used in this study.

$NE_a = C_a \times NE_m$ [Eq. 5]

NE_a is the net energy for animal activity, MJ day^{-1}.

C_a is the coefficient, dimensionless, corresponding to animal's feeding situation. In this study, we used a value of 0.14, 0.14 and 0.019 for dairy cattle, beef cattle and meat goats, respectively, as per IPCC 2019 guideline.

$NE_l = Milk \times (1.47 + 0.40 \times Fat)$ [Eq. 6]

NE_l is the net energy for lactation, MJ day^{-1};

Milk is the amount of milk produced, kg of milk day^{-1}. It was used as a measured input was used in this study;

Fat is the fat content of milk, percent by weight. It was used as a measured input was used in this study.

$NE_w = 0.10k \times NE_m \times Hours$ [Eq. 7]

NE_w is the net energy for work, MJ day^{-1};

NE_m is the net energy required by the animal for maintenance, MJ day^{-1};

Hours is the number of hours of work per day. It was used as a measured input was used in this study.

$NE_p = C_{pregnancy} \times NE_m$ **[Eq. 8]**

NE_p is the net energy for pregnancy, MJ day^{-1}.

$C_{pregnancy}$ is the pregnancy coefficient; we used a value of 0.01 for dairy cattle, as per IPCC 2019 guideline.

NE_m is the net energy required by the animal for maintenance, MJ day^{-1};

$REM = [1.123 – (4.092 \times 10^{-3} \times DE) + (1.126 \times 10^{-5} \times (DE)^2 – (25.4 / DE)$ **[Eq. 9]**

Under circumstances of project area, a **DE%** of 70 was used in the study as per IPCC 2019 guideline.

$NE_g = 22.02 [(BW / (C \times MW)]^{0.75} \times WG^{1.097}$ [Eq. 10]

NE_g is the net energy needed for growth, MJ day^{-1};

BW is the average body weight of the animals in the population, kg; it was used as a measured input was used in this study;

C is the coefficient, we used a value of 0.8 and 1.2 for dairy cattle an, beef cattle, respectively, as per IPCC 2019 guideline;

MW is the mature body weight of an adult animal individually under moderate body conditions, kg; it was used as a measured input was used in this study; and

WG is the average daily weight gain of the animals in the population, kg day^{-1}; it was used as a measured input was used in this study.

$REG = [1.164 – (5.16 \times 10^{-3} \times DE) + (1.308 \times 10^{-5} \times (DE)^2 – (37.4 / DE)$

Under circumstances of project area, a **DE%** of 70 was used in the study as per IPCC 2019 guideline [Eq. 11].

As required as the inputs of the equations, mentioned above, data on body weight, rate of weight gain, milk fat content and annual milk production for dairy cattle; body weight, rate of weight gain and carcass weight for beef cattle; and body weight, rate of weight gain, weaning weight, and carcass weight for meat goat were collected through the baseline line survey. A conversion factor of 0.50 was used to estimate carcass weight from the live weight of cattle, while a factor of 0.52 was applied for carcass weight of goats. Under the country perspective, those conversion factors were assumed through expert consultation (Dr. Nathu Ram Sarker, Former Director General, Bangladesh Livestock Research Institute (BLRI), Savar, Bangladesh).

In addition to calculating the emissions per animal basis, the emissions were also estimated for unit productivity of the animals (milk or meat). This was done by dividing the total annual emission of individual animals by total annual production (milk or meat).

The CO_2 equivalent methane emission of individual animals within the three animal categories (dairy cattle, beef cattle and goats) were synthesized as mean and standard deviation of each category, and breed type and 16 study regions with the categories.

All the data are stored in the prescribed database system of ACDI/VOCA.

4.3 METHANE EMISSION FROM DAIRY CATTLE

Table 4.1 shows, on average, the methane emissions from dairy cattle were estimated as 1686±609 kg CO_2.eq $head^{-1}$ yr^{-1} (± is SD and n = 397). This emission was higher in crossbred (2,050±527 kg CO_2.eq $head^{-1}$ yr^{-1}; n = 228) than in local breeds (1,196±276 kg CO_2.eq $head^{-1}$ yr^{-1}; n = 169).

Table 4.1: Estimated average methane emission per dairy cattle per year by breed types

	Emission (CO_2e) ±SD (kg)	
Breed Types	Baseline	FAO 2022*
Crossbred	2,050±527	-
Local	1,196±276	-
Overall	1,686±609	1877

*Data source: https://www.fao.org/faostat/en/#data/EI/visualize

Table 4.2 shows, on a unit productivity basis, the estimated average methane emission was 2.7±2.1 kg CO_2.eq kg^{-1} milk (± is SD and n = 397). On the contrary to per head emission, local breeds emitted higher methane per unit productivity (4.2±2.4 kg CO_2.eq kg^{-1} milk; n = 169) than crossbred (1.6±1.0 kg CO_2.eq kg^{-1} milk; n = 228).

Table 4.2: Estimated average methane emission per one liter of milk by breed types

	Emission (CO_2e) ±SD (kg)	
Breed Types	Baseline	FAO 2022*
Crossbred	1.6±1.0	-
Local	4.2±2.4	-
Overall	2.7±2.1	1.38

*Data source: https://www.fao.org/faostat/en/#data/EI/visualize

Using FAOSTAT data specific to Bangladesh, we compared the baseline estimations with the FAO 2022 estimations of CH_4 emissions. The range (denoted by SD) of the overall methane emission per dairy cattle per year and unit productivity in the baseline estimation within the FAO 2022 estimations.

Estimated emissions per region varied slightly but were usually not statistically significant (Table 4.3).

Table 4.3: Estimated average methane emission per one liter of milk by district

District	Emission (CO_2e) ±SD (kg)
Bogura	2.5±1.7
Chuadanga	3.5±3.6
Gaibandha	3.4±1.8
Jamalpur	3.1±1.1
Jashore	3.1±2.7
Jhenaidah	2.6±1.9
Joypurhat	1.5±0.9
Kurigram	5±2.8
Kushtia	2.1±1.3
Noagaon	2.7±2.7
Natore	2.3±1.8
Pabna	1±0.2
Rajshahi	2.5±1.2
Rangpur	3.3±2.2
Satkhira	3.6±1.2
Sirajganj	1.9±1.7
Average	2.7±2.1

4.4 METHANE EMISSION FROM BEEF CATTLE

Table 4.4 shows, on average, beef cattle produced 974±251 kg CO_2.eq head^{-1} yr^{-1} of total methane (± is SD and n = 281). Like dairy cattle, the methane emission was higher in crossbred (1,041±241 kg CO_2.eq head^{-1} yr^{-1}; n = 175) than in local breeds (863±227 kg CO_2.eq head^{-1} yr^{-1}; n = 106).

Table 4.4: Estimated average methane emission per beef cattle per year by breed types

	Emission (CO_2e) ±SD (kg)	
Breed Types	Baseline	FAO 2022*
Crossbred	1,041±241	-
Local	863±227	-
Overall	974±251	864

*Data source: https://www.fao.org/faostat/en/#data/EI/visualize

Table 4.5 shows that on a unit productivity basis, the estimated average methane emission was 11.2±3 kg CO_2.eq kg^{-1} cattle meat (carcass) (n=281). Local breeds emitted higher methane per unit productivity (12.6±4 kg CO_2.eq kg^{-1} meat; n=106) than crossbred (10.3±1.7 kg CO_2.eq kg^{-1} meat; n = 175).

Table 4.5: Estimated average methane emission by one kg of cattle carcass by breed types

	Emission (CO_2e) ±SD (kg)	
Breed Types	Baseline	FAO 2022*
Crossbred	10.3±1.7	-
Local	12.6±4	-
Overall	11.2±3	12.0**

*Data source: https://www.fao.org/faostat/en/#data/EI/visualize

** Calculation based on carcass yield of 72.0 kg per slaughtered cattle

Like emissions from dairy cattle, we used FAOSTAT data specific to Bangladesh for comparing the baseline estimations with FAO 2022 estimations CH_4 emissions. The range (denoted by SD) of the overall methane emission per beef cattle per year and unit productivity in the baseline estimation are within the FAO 2022 estimations.

Estimated emissions per region varied slightly but were usually not evident (Table 4.6).

Table 4.6: Estimated average methane emission by one kg cattle carcass by districts

District	Emission (CO_2e) ±SD (kg)
Bogura	11.4±1.6
Chuadanga	9.9±1.8
Gaibandha	11.7±0.7
Jamalpur	11.6±2
Jashore	11±3.1

District	Emission (CO_2e) ±SD (kg)
Jhenaidah	10.5±1.6
Joypurhat	12.6±2.5
Kurigram	14.2±5.9
Kushtia	9.6±2
Noagaon	10.1±1.3
Natore	11±2.2
Pabna	9.4±1.8
Rajshahi	10.9±1.1
Rangpur	12.5±2.8
Satkhira	14.4±4.6
Sirajganj	10.5±1.8
Average	11.2±3

4.5 METHANE EMISSION FROM GOAT MEAT

Table 4.7 shows that a goat produced 90±28 kg CO_2.eq head^{-1} yr^{-1} of methane (n = 566). Like dairy cattle and beef cattle, the methane emission was higher in crossbred (118±32 kg CO_2.eq head^{-1} yr^{-1}; n = 124) than in local breeds (82±20 kg CO_2.eq head^{-1} yr^{-1}; n = 442).

Table 4.7: Estimated average methane emissions per goat by breed types

	Emission (CO_2e) ±SD (kg)	
Breed Types	Baseline	FAO 2022*
Crossbred	118±32	-
Local	82±20	-
Overall	90±28	155

*Data source: https://www.fao.org/faostat/en/#data/EI/visualize

Table 4.8 shows that on a unit productivity basis, the estimated average methane emission was 14.6±1.3 kg CO_2.eq kg^{-1} cattle meat (carcass) (n=566). Local breeds emitted higher methane per unit productivity (14.9±1.3 kg CO_2.eq kg^{-1} meat; n = 442) than crossbred (13.4±0.9 kg CO_2.eq kg^{-1} meat; n = 124).

Table 4.8: Estimated average methane emissions per one kg goat carcass by breed types

	Emission (CO_2e) ±SD (kg)	
Breed Types	Baseline	FAO 2022*
Crossbred	13.4±0.9	-
Local	14.9±1.3	-
Overall	14.6±1.3	8.6**

*Data source: https://www.fao.org/faostat/en/#data/EI/visualize

** Calculation based on carcass yield of 18.0 kg per slaughtered goat

Like emissions from dairy cattle and beef cattle, we used FAOSTAT data specific to Bangladesh for comparing the baseline estimations with FAO 2022 estimations CH_4 emissions. The range (denoted by SD) of the overall methane emission per goat per year in the baseline estimation fell below the FAO 2022 estimation. On the other hand, the range (denoted by SD) of the overall methane emission per unit goat in the baseline estimation fell above the FAO 2022 estimation. The discrepancy, as a quick observation, probably occurred due to the size of the animals – the average carcass weight in the baseline was 6.5 kg, whereas it as 18.0 kg in the FAO 2022 data.

It may be noted again that the baseline study followed the IPCC Tier 2 methodology in estimating the emissions, whereas FAO 2022 data was based on IPCC Tier 1 methodology. We discussed this particular issue with the technical experts from the government (Department of Livestock Services (DLS) and Bangladesh Livestock Research Institute (BLRI). Bangladesh government has begun GHG estimations switching IPCC Tier 1 to IPCC Tier 2 methodology. The Bangladeshi experts suggested to keep the current data as it is at the current moment.

Estimated emissions per region varied slightly, but usually not evident (Table 4.9).

Table 4.9: Estimated average methane emission per one kilogram (kg) of goat carcass by district

District	Emission (CO_2e) ±SD (kg)
Bogura	15.2±1.5
Chuadanga	13.7±0.5
Gaibandha	14.4±1.0
Jamalpur	14.9±1.2
Jashore	14.4±1.3
Jhenaidah	14.3±1.9
Joypurhat	14.5±0.9
Kurigram	14.5±0.9
Kushtia	15.1±1.4
Noagaon	14.4±1.4
Natore	14.6±1.6
Pabna	14.7±1.4
Rajshahi	14.2±1.5
Rangpur	14.8±1.1
Satkhira	15.3±0.9
Sirajganj	14.2±1.3
Average	14.6±1.3

5. CROSS-CUTTING ISSUES

5.1 WOMEN AND YOUTH ENGAGEMENT

The analysis of women and youth engagement in cattle management within the project area offers valuable insights into gender dynamics and youth participation. While female-headed households accounted for only 4.3 percent of the 1,753 surveyed households, the baseline study showed that women played an important role in livestock management in approximately 47 percent of all households. Despite limited formal ownership, women's contributions to agricultural activities are substantial. A village-level survey in Cumilla district (CDP-UNFPA, 2020) found that 15.2 percent of households were female-led, closely aligning with Mahbub's 2023 study (15.4 percent) based on the 2010 Household Income and Expenditure Survey, and national statistics from the Bangladesh Bureau of Statistics (BBS, 2022), which reported 15.0 percent.

Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) emphasized that assessing women's engagement solely based on household ownership can be misleading. Although women often lack formal land or household ownership, their contributions to livestock management are crucial. The project should leverage these insights to promote women's inclusion in training, decision-making, and leadership roles within producer groups and livestock-related initiatives.

Youth engagement in cattle management was relatively low, with only 7.3 percent of surveyed households reporting active participation by youth (defined as individuals aged 18 to 35). Female youth had slightly higher participation (4.2 percent) compared to male youth (3.1 percent). Limited access to financial resources restricts youth from investing in and adopting improved practices. However, youth represent a vital demographic for introducing innovative techniques and enhancing agricultural productivity. FGDs and KIIs highlighted that sustained youth engagement is critical for advancing and maintaining cattle management practices in rural areas. To address these challenges, targeted interventions are necessary to increase youth participation in cattle management. These should include tailored credit schemes, specialized training programs, and youth-friendly financial inclusion strategies. The higher engagement of female youth in improved practices also present an opportunity to prioritize interventions that support their contributions and leadership in livestock activities, fostering greater female participation and long-term sustainability in the sector.

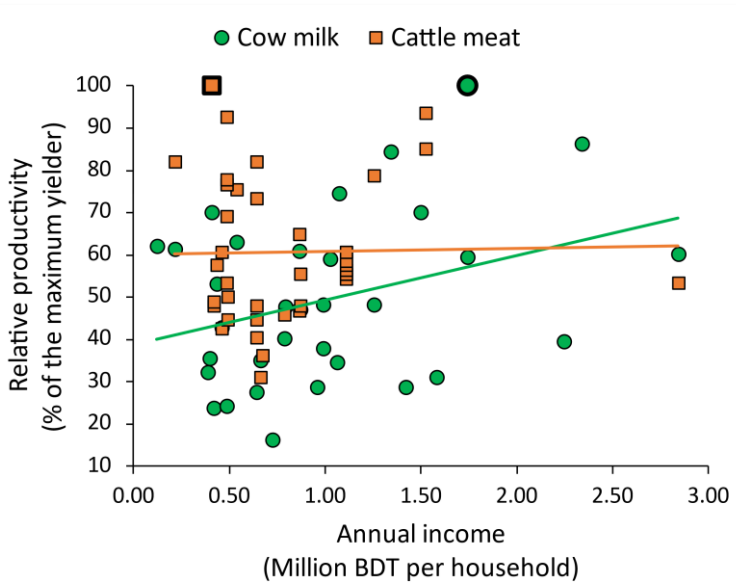
6. KEY DISCUSSIONS

6.1 HOUSEHOLD INCOME AND PRODUCTIVITY RELATION

The project aims for increased production volume of cattle milk and cattle meat (carcass), where productivity would play a dominant role. We hypothesize that productivity relates to the capacity to invest, where the capacity is a function of the annual income of the households. We tested the hypothesis with the available baseline survey data of medium households, 33 cattle milk, and 39 cattle meat animals. We deduced the relationship between the annual household income and relative cow milk and cattle meat (carcass) productivity. The relative yield (of milk or meat) was calculated as the percentage of the individual yield to the maximum yield of the samples.

Results presented in Figure 6.1 show that there was a small, but insignificant, trend in the increase of relative milk productivity (R^2 = 0.01129) over the increasing household income. On the other hand, there was a little and insignificant trend in the increase of relative meat productivity (R^2 = 0.0005) over the increasing household income. From the results, we conclude that the capacity to invest does not necessarily guarantee milk and meat productivity in the project area. The baseline team could not identify the exact reasons for that; because such results were not expected and/or anticipated before undertaking the field survey. The results raise several key questions such as, whether households did not invest adequately in the livestock sector or whether the management systems they employed were not effective. Further investigation is needed to understand these dynamics and identify contributing factors so that the project can right interventions to improve productivity.

Figure 6.1: Association between average household income and relative milk and meat productivity. The deep-bordered filled square and deep-bordered circle denoted the highest yield of cattle meat (carcass) and cow milk, respectively in the samples.



6.2 GREENHOUSE GAS EMISSIONS IN RELATION TO PRODUCTIVITY

The baseline analysis quantified the relationship between cow milk, cattle meat (carcass), and goat meat productivity and methane-sourced GHG emissions (Figures 6.2, 6.3, and 6.4). This interesting relationship is that increasing productivity could reduce GHG emissions per unit of cattle milk, cattle meat (carcass), and goat meat production systems. All cattle and goats produce methane as they undergo enteric fermentation, so animals with higher milk and meat production will naturally produce less methane per unit of milk or meat.

Figure 6.2: Relationship between cow milk productivity and CO_2.eq methane gas emissions (Y = 3.4306 X-0.68), n = 398

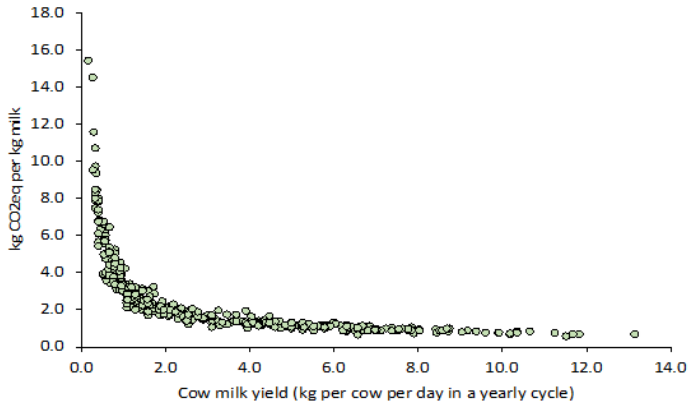


Figure 6.3: Relationship between cattle meat (carcass) productivity and CO_2.eq methane gas emissions (Y = 130.73 $X^{-0.452}$), n = 282

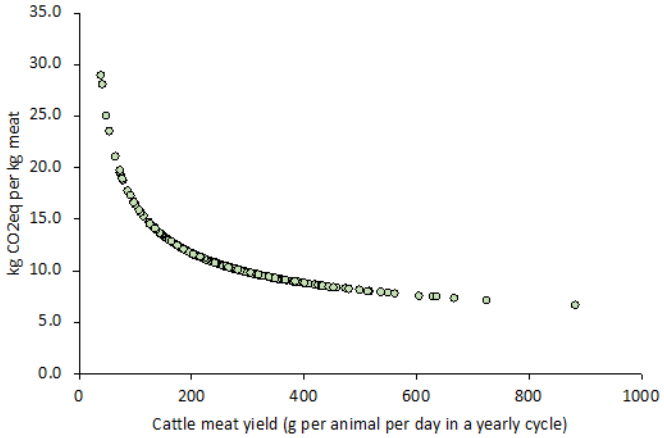
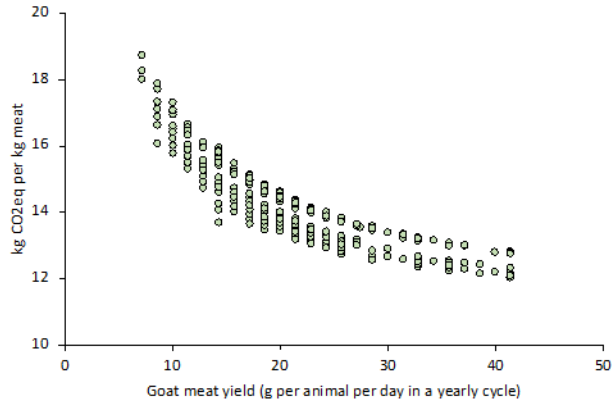


Figure 6.4: Relationship between goat meat productivity and CO_2.eq methane gas emissions (Y = 27.606 $X^{-0.226}$), n = 826



6.3 MANURE MANAGEMENT

Table 6.1 presents the manure management practices among 1,753 surveyed households. Half of the households (50 percent) dispose of manure by dumping it outside the cattle shed, a method that can lead to environmental pollution if not managed properly. Burning manure for fuel is practiced by 40 percent of households, providing an energy source but potentially contributing to indoor air pollution and loss of valuable nutrients that could enhance soil fertility. Composting manure into fertilizer is adopted by 7 percent of households, a practice that improves soil health and reduces reliance on chemical fertilizers. A smaller fraction, 3 percent, engages in selling raw manure, indicating a market for manure as a resource. These findings highlight the need for promoting sustainable manure management practices to maximize agricultural benefits and minimize environmental impacts.

Table 6.1: Manure management by surveyed households

Types of manure processing	Number of households	Percentage of households
Dump outside cattle shed	876	50
Burned for fuel	701	40
Compost fertilizer	122	7
Selling raw manure	51	3
Total	1,753	100

Manure management practices significantly influence GHG emissions, particularly methane (CH_4) and nitrous oxide (N_2O) production. According to the IPCC manual and experts interviewed during KIIs, methane is predominantly released during the anaerobic decomposition of manure, especially when dumped or left unmanaged. Cross practices such as composting reduce methane emissions but can result in a slight increase in nitrous oxide levels. This tradeoff was discussed in detail during consultations with environmental experts, who highlighted the EPA guidelines as evidence that the net effect of such practices is a significant reduction in overall GHG emissions.

Farmers participating in FGDs, however, demonstrated limited awareness of the relationship between manure management and GHG emissions and perceived manure primarily as a fuel source or waste

product, overlooking its broader environmental implications. Key challenges include awareness gaps, as many farmers are unfamiliar with the impacts of improper manure management; infrastructure limitations, such as the absence of composting facilities that would enable more sustainable practices; and economic barriers, where weak market linkages and low demand hinder the sale of value-added manure products like dried fuel bars or organic fertilizer.

To address the challenges of manure management, the project may initiate a comprehensive Behavior Change (BC) study to understand the underlying motivations and attitudes driving current practices. Based on these insights, an BC strategy can be developed to promote innovative manure management techniques followed by piloting these improved practices in targeted areas can showcase their benefits, including reduced waste, lower methane emissions, enhanced soil health, and income generation through manure commercialization. This approach not only mitigates environmental impacts but also improves sustainability and strengthens community resilience.

7. KEY LEARNING QUESTIONS

Learning question 1: What are the levels of GHG emissions per unit of production (milk, beef, and goat meat) and what are recommendations for reducing emissions efficiently?

The estimated average methane emissions were 2.7 kg CO_2.eq per kg of milk, with local breeds emitting significantly more (4.2 kg CO_2.eq per kg of milk) compared to crossbred (1.6 kg CO_2.eq per kg of milk). For cattle meat (carcass), methane emissions averaged 11.2 kg CO_2.eq per kg, with local breeds emitting higher levels (12.6 kg CO_2.eq per kg of meat) than crossbred (10.3 kg CO_2.eq per kg of meat). Similarly, for goat meat, the average methane emissions were 14.6 kg CO_2.eq per kg, with local breeds emitting 14.9 kg CO_2.eq per kg of meat compared to 13.4 kg CO_2.eq for crossbred. Further details on these findings are provided in Section 4 (GHG Emissions), along with strategies for efficient emission reduction outlined in Section 8 (Recommendations).

Learning question 2: What strategies and approaches are most successful at incentivizing desired behavior changes of government staff?

The BCSL project aims to enhance productivity and trade in the livestock sector while reducing greenhouse gas emissions. Key government bodies, including the Department of Livestock Services (DLS) and the Department of Environment (DoE), play critical roles in improving livestock productivity and mitigating GHG emissions, while the Bangladesh Livestock Research Institute (BLRI) provides essential technical expertise. To address this learning question, discussions were conducted with government and non-government stakeholders in the livestock sector through key informant interviews and workshops.

Currently, government staff often view their approaches as sufficient and may perceive non-government initiatives in similar areas as potential challenges to their credibility. However, the outcomes of the BCSL project are designed to support and align with government efforts, offering complementary benefits. Building understanding and collaboration with government officials is crucial to prevent any misperception that BCSL's efforts are competitive rather than supportive. This approach will help ensure effective partnership and shared progress toward common goals in the livestock sector.

The BCSL project will emphasize continuous rapport-building and seamless collaboration through a series of strategic actions. The project will offer government officials membership in its steering committee and engage focal points from the Department of Livestock Services (DLS), Department of Environment (DoE), and Bangladesh Livestock Research Institute (BLRI) in annual planning and reporting sessions, fostering a sense of ownership. Senior officials from these departments will be invited on field visits for direct exposure to project activities, while selected key government actors will have opportunities for sponsored international training to enhance their expertise. Additionally, the project will conduct on-station trials at BLRI facilities, directly involving national research resources. During visits from international staff and experts, government officials, including retired national experts, will be invited to participate in briefings, creating a shared platform for knowledge exchange. Finally, the project will arrange training and advocacy sessions for government officials, ensuring practical support at the field level and accountability to all stakeholders. This multifaceted

approach aims to strengthen collaboration, mitigate misunderstandings, and position the BCSL project as a valued ally in advancing productivity and sustainability in the livestock sector.

Learning question 3: Using a cost-benefit analysis, what is the net profit from current livestock production techniques and management practices, including feeding, pest, and disease management?

The baseline study evaluated the profitability of livestock production by examining income and expenditure patterns among Marginal, Smallholder, and Medium-scale farmers. Data was gathered from surveyed households to assess their total income from livestock production and their expenditures on livestock management over the past 12 months. This analysis aims to determine the net profit generated by different categories of farmers - Marginal, Smallholder, and Medium based on their income and expenditure patterns.

Income analysis

Household income sources in livestock farming include sales of milk, cattle trading, cow dung, and goats. Table 7.1 indicates that medium-scale households generate the highest annual income at BDT 608,880, driven by their larger herd size, which enables higher milk production and increased livestock sales. Smallholder households, with moderate herd sizes, earn an average of BDT 275,295 per year, benefiting from a balanced mix of milk sales and livestock trading. In contrast, marginal households, operating with limited livestock, report the lowest income at BDT 98,258 annually. While milk remains a key revenue source across all household categories, smallholders and medium-scale farmers further enhance their earnings through cattle sales, contributing to higher overall income levels.

Table 7.1: Annual income (BDT) from livestock production by household categories

Household categories	Selling milk	Cattle trading	Selling cow dung	Selling goat	Average Income BDT/HH
Marginal	66,835	105,406	3,555	20,357	98,258
Smallholder	118,713	243,592	7,000	19,913	275,295
Medium	211,843	447,700	1,750	25,125	608,880
Average Income	85,355	180,175	4,126	20,474	160,948

Expenditure analysis

Expenditures in livestock farming are shaped by key factors such as feeding practices, health management, livestock purchases, and operational costs. Table 7.2 shows that medium-scale farmers incur the highest annual costs at BDT 234,057, reflecting significant investments in concentrate feed, green grass, silage, straw, and veterinary care. Their substantial spending on cattle purchases further supports herd expansion and productivity growth.

Smallholder farmers maintain a moderate expenditure of BDT 103,565, striking a balance between feeding costs and herd maintenance. In contrast, marginal farmers, managing fewer cattle, report the lowest expenditure at BDT 47,280, primarily covering essential feed and disease prevention, ensuring basic livestock health and productivity.

Table 7.2: Annual expenditure (BDT) on livestock management by household categories

Household Categories	Green Grass	Silage	Seed grass	Rice straw	Concentrate feed	Health management	Purchase ruminant	Transportation	Other costs	Average expenditure /HH
Marginal	13,005	-	7,262	20,018	38,415	4,936	129,289	875	416	47,280
Smallholder	26,285	20,950	58,634	37,487	86,006	12,394	125,108	1,814	1,209	103,565
Medium	37,729	40,400	3,000	52,083	171,770	25,715	363,500	4,963	1,208	234,057
Average	17,942	33,917	26,767	25,200	55,714	7,517	152,319	1,872	723	66,955

Profitability analysis

Net profit, determined as sales revenue minus expenditure, reflects a positive financial return on livestock farming across all categories. Medium-scale farmers achieve the highest net profit of BDT 374,823, highlighting the benefits of economies of scale in livestock production. Smallholder farmers generate a net profit of BDT 171,730, leveraging diversified income sources and controlled expenditures. Meanwhile, marginal farmers, despite lower income levels, secure a net profit of BDT 50,978, demonstrating that even small-scale livestock farming can remain financially viable with prudent expense management (Table 7.3). It is recommended that the project carries out further studies to better understand the returns on investment by the three categories of livestock owners and recommend appropriate levels and types of investments.

Table 7.3: Net profit (BDT) from livestock per year by household categories

Household categories	Sales revenue	Total expenditure	Net profit /HH
Marginal	98,258	47,280	50,978
Smallholder	275,295	103,565	171,730
Medium	608,880	234,057	374,823
Average	160,948	66,955	93,993

Learning question 4: Are there differences in revenue or income for different types of LSPs (adult men, adult women, male youth, and female youth)? What are the main factors or challenges that contribute to differences?

Local Service Providers (LSPs) in the surveyed areas exhibit significant income disparities based on various factors such as gender, experience, location, and the size of their customer base. On average, LSPs particularly women who offer basic advisory services and limited treatments earn between BDT 5,000 and BDT 10,000 per month. In contrast, more established LSPs mainly men serving larger areas and providing comprehensive services can earn between BDT 25,000 and BDT 50,000 per month. The number of male LSPs is notably higher than that of female LSPs, with a ratio of 6:1. Self-initiated entrepreneur LSPs were found to be the most proactive in seeking capacity-building training and actively engaging with communities to share knowledge and provide services. Two male LSPs entrepreneurs mentioned, 'Selling medicines and quality inputs has helped me expand my business and serve more farmers. Over the past few years, we've noticed more households investing in better products and services for their livestock.

The income gap between male and female LSPs is driven by a range of interconnected barriers. A key issue is the common belief among farmers that male LSPs are more skilled, leading to higher demand for their services. This bias is reinforced by the perception that men are better at handling animals, further discouraging farmers from engaging female LSPs. Additionally, cultural barriers and security concerns limit women's mobility, restricting the geographic areas they can cover. While male LSPs can work freely from day to night, female LSPs face limitations in this regard. Furthermore, young female LSPs often discontinue their work after marriage, adding another layer to the gender disparity in this field.

Male LSPs also benefit from larger customer bases, stronger networks with input dealers, and easier access to markets and Department of Livestock Services (DLS) offices, which enable them to secure more clients and negotiate better deals. Furthermore, the limited capital available to female LSPs constrains their ability to scale their businesses. Compounding these barriers, the DLS often restricts female LSPs from providing treatments due to perceived skill gaps, limiting their services to advisory roles. There is also tension between LSPs and DLS veterinarians, as the latter fear income loss due to LSPs offering services beyond primary health treatments, despite the DLS having insufficient capacity to serve all animals in their jurisdiction.

Recommended strategies to reduce income disparities

1. **Capacity building**: Offering long-term, hands-on practical training for female LSPs can enhance their skills and build confidence among farmers regarding their capabilities. This will help in overcoming biases related to animal handling and service quality.
2. **Addressing cultural barriers**: Local government and community-based organizations can play a key role in addressing the cultural barriers that limit women's mobility and participation in livestock services. Awareness campaigns promoting gender equality and the economic benefits of engaging female LSPs can help shift community mindsets.
3. **Increased access to capital**: Facilitating access to low-interest loans or grants for female LSPs will enable them to expand their service offerings, cover larger areas, and invest in necessary equipment, start the input business with legal process for leveling the playing field with male LSPs.
4. **Strengthening networks and market linkages**: Female LSPs should be provided with opportunities to build stronger networks with input suppliers, markets, and the DLS. Organizing networking events and creating platforms for collaboration will enhance their market presence and client base.
5. **Formal recognition by DLS**: Building stronger coordination between the DLS and LSPs, where LSPs can be recognized as local agents of the DLS, will help legitimize their role in livestock management. This could foster trust and cooperation, allowing female LSPs to provide treatments under DLS supervision and gain more business.

8. RECOMMENDATIONS

To achieve the results of the BCSL project, the baseline study recommends:

8.1 The development of the strategic pathway for achieving the two strategic objectives of the project;
8.2 The approach for implementing the strategic pathway;
8.3 The structure of the enabling environment for successful implementation;
8.4 Interventions for the development of the milk system and the cattle meat system
8.5 Interventions for the development of the market system, and
8.6 Interventions in the manure management system.

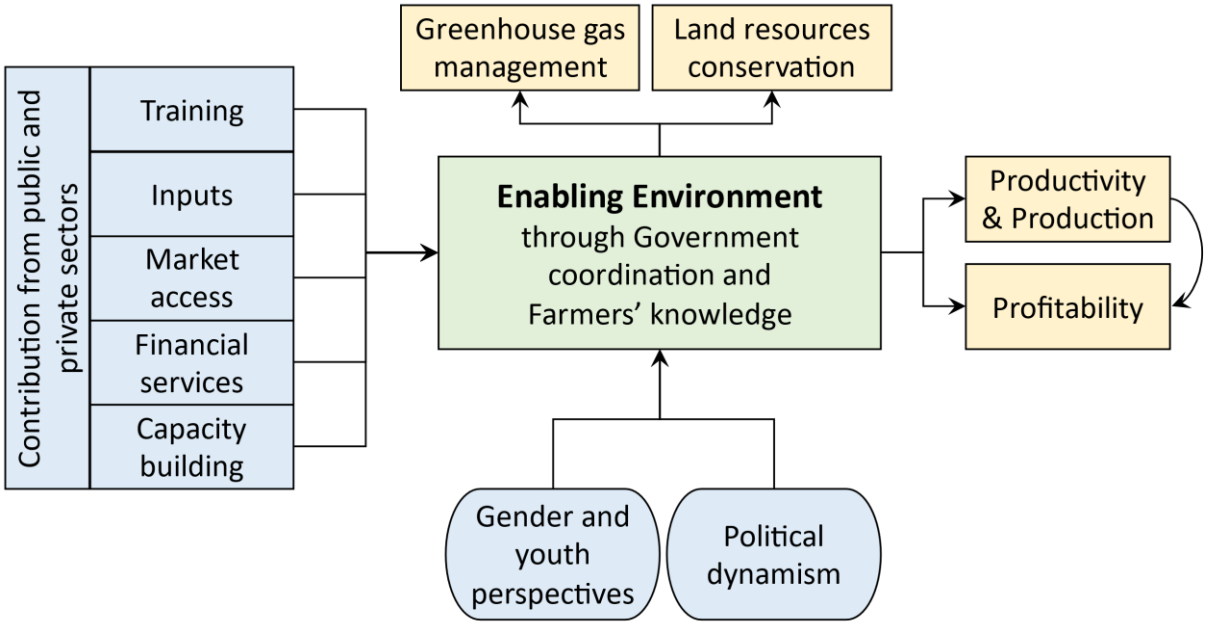
8.1 STRATEGIC PATHWAYS TO ACHIEVING TWO STRATEGIC OBJECTIVES

The strategy places the **'enabling environment'** at its core (Figure 8.1), fostering its development through coordinated government initiatives and enhanced farmer knowledge, with the project playing a supportive and facilitative role.

Key project activities—including beneficiary training, improved access to inputs, markets, financial services, and overall capacity development—will contribute to building this enabling environment. Additionally, fostering women's engagement and empowerment, alongside efforts to revitalize the livestock sector, will be driven by women and youth-inclusive approaches, backed by strong political commitment. These combined efforts will lead to two key outcomes:

- **Increased productivity, production, and profitability**
- **Effective greenhouse gas management and sustainable land resource conservation**

Figure 8.1: The sketch of strategic pathways for achieving the strategic objectives of the project



8.2 THE APPROACH

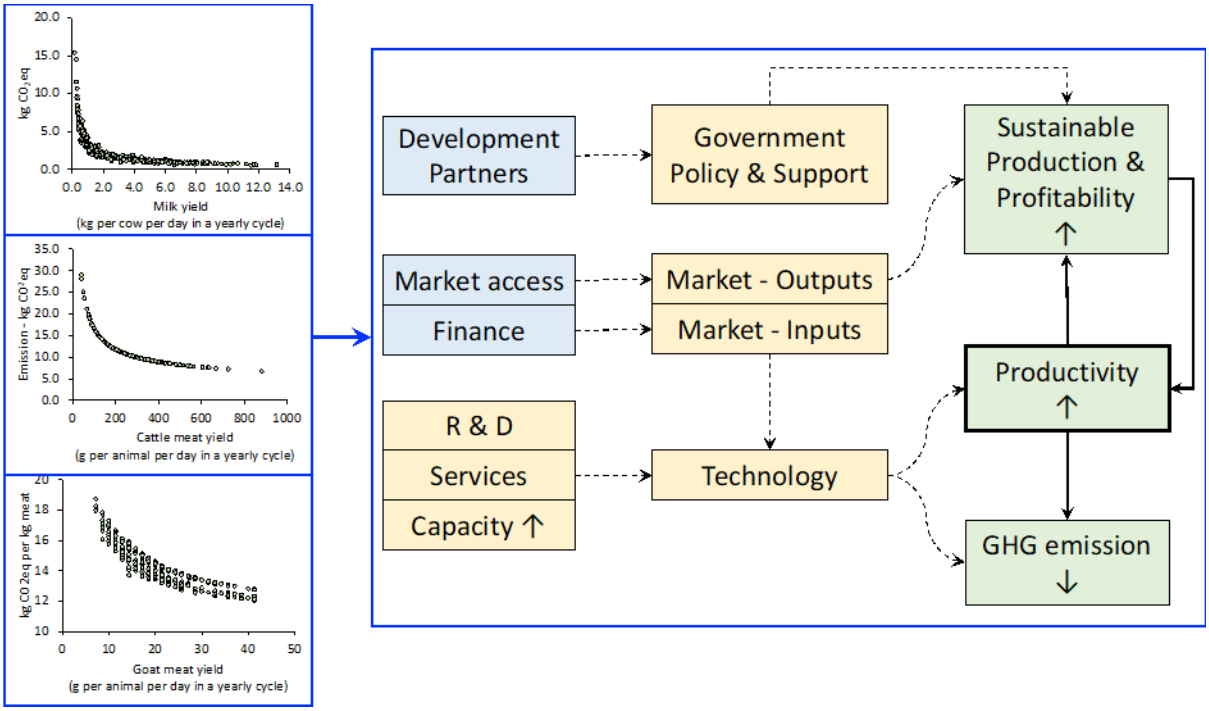
The proposed approach, a prototype of the Theory of Change (ToC), aims to enhance productivity in cow milk, cattle meat (carcass), and goat meat systems (Figure 8.2). The relationship between productivity and greenhouse gas (GHG) emissions is based on an "estimated system influencer," suggesting that higher productivity contributes to lower emissions per unit of milk and meat produced rather than creating a trade-off.

Technology is the primary driver of productivity, and when effectively designed, it can also mitigate GHG emissions. The technological inputs are categorized into two key groups. **Group 1** comprises Research and Development (R&D), services, and capacity development, which collectively support the achievement of USDA FFPr Strategic Objective 01.

Group 2 focuses on improving market access to inputs, which is inherently linked to the availability of appropriate financial services. The sustainability of the system depends on increased productivity, which becomes self-sustaining when supported by a stable market for product sales, facilitated through effective market access mechanisms.

Government policies and support are essential in ensuring sustainable and profitable production, while development partners play a critical role in shaping policy frameworks and support mechanisms. These efforts collectively contribute to achieving USDA FFPr Strategic Objective 02.

Figure 8.2: The approach centering to be used in the strategic pathway for increasing productivity



8.3 THE STRUCTURE OF ENABLING ENVIRONMENT

The structure of the enabling environment, discussed in section A, has three components: (i) Production and Connectivity, (ii Infrastructure Support system, and (iii) Producers' Association. Activities are suggested for each of the components in Table 8.1.

Table 8.1: The structure of the enabling environment

Component	Activity
Production and connectivity	I. Enable resilience for disasters II. Formulate a supply chain for accessing inputs III. Explore innovative production systems
Infrastructure support system	IV. Find and/or adopt dependable financial access channel(s) V. Add value to the existing market systems to make them stabilized and efficient for the producers and other market actors
Producers' association	VI. Introduce the 'Collective Action' approach VII. Engage women and youth to support the collective actions VIII. Aggregate farm produces to strengthen producers' capacity to buy and sell products with the negotiated price.

8.4 INTERVENTIONS FOR DEVELOPMENT OF THE MILK AND MEAT SYSTEM

Interventions within the system should be tailored to the specific categories of cattle-rearing households (HHs) as outlined in Tables 8.2 and 8.3. For marginal HHs, the most practical intervention is animal health management. For smallholder and medium HHs, a combination of animal health management and feed management is recommended. Common intervention strategies include observation, information dissemination, and provision of services. Additionally, for households engaged in milk production, the focus should include improved fodder cultivation and the use of additives to enhance milk fat content. These targeted interventions aim to optimize productivity and health outcomes across different household categories.

Table 8.2: Household category-wise interventions for dairy cattle systems

Household category	Breed types	Intervention	Means
Marginal	Local Crossbred	○ Health management	○ Observation ○ Information ○ Services ○ Improved fodder cultivation ○ Additives for fat improvement
Smallholder	Local Crossbred	○ Health management ○ Feed management	
Medium	Local Crossbred	○ Health management ○ Feed management ○ Cattle-shed management	

Table 8.3: Household category-wise interventions for beef cattle systems

Household category	Breed type	Intervention	Means
Marginal	Local Crossbred	○ Health management	○ Observation ○ Information ○ Services
Smallholder	Local Crossbred	○ Health management ○ Feed management	
Medium	Local Crossbred	○ Health management ○ Feed management ○ Cattle-shed management	

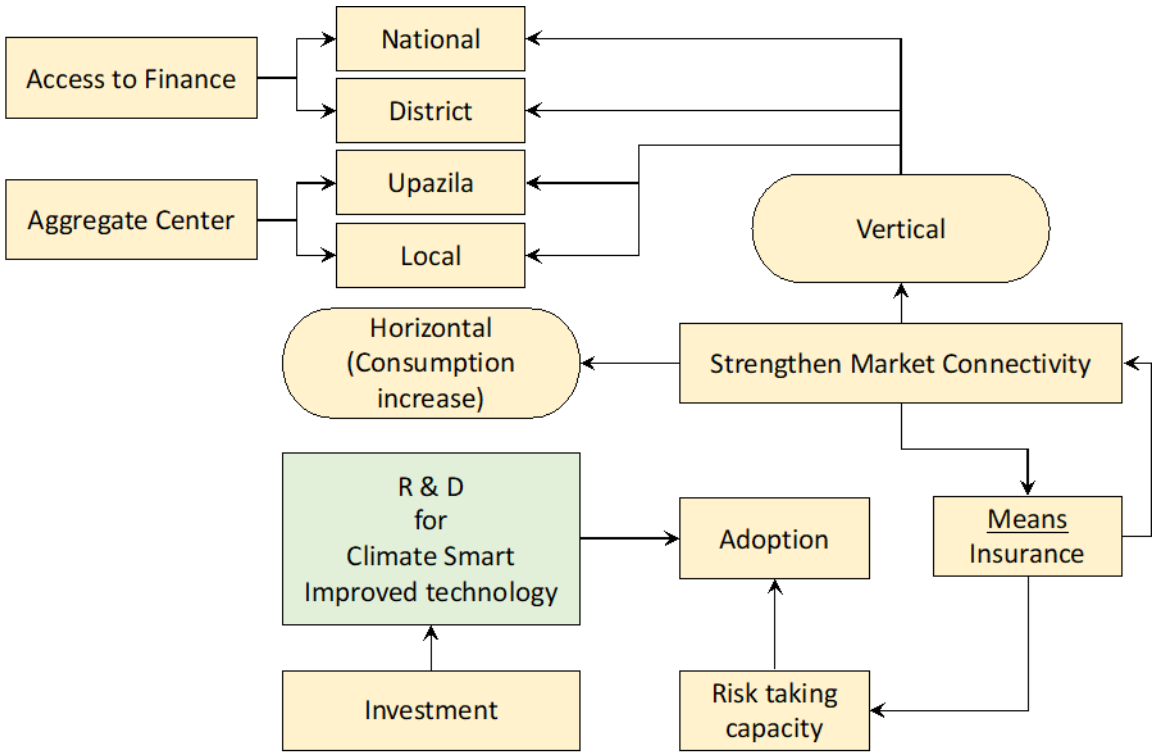
8.5 MARKET SYSTEM DEVELOPMENT

Enhancing market connectivity is essential for developing a robust market system (Figure 8.3). This can be achieved through two key dimensions: horizontal and vertical integration.

Horizontal connectivity focuses on increasing the consumption of milk and meat while expanding market access at the community level. **Vertical connectivity** involves the establishment of aggregation centers at local and upazila levels, facilitating more efficient supply chains.

Additionally, improving access to finance is crucial for strengthening market linkages at district and national levels, fostering a more integrated, resilient, and efficient market system.

Figure 8.3: Strengthening connectivity with the input and output market



8.6 INTERVENTIONS IN MANURE MANAGEMENT CONTRIBUTING TO REDUCTION OF GREENHOUSE GAS (GHG) EMISSION

System interventions should be tailored to specific household categories, focusing on three key aspects: feed, breeding, and cow dung management (Table 8.4). This is expected to contribute to the productivity and income, and therefore, provide a positive return on investment. This cost and returns of the interventions can be studied subsequently

For medium-sized households, feed management is the primary recommendation. Breeding interventions are appropriate for both smallholder and medium-sized households. Cow dung management strategies vary by household type. For marginal and small households, direct practices such as storing dung in 50 kg sealed containers for sale or composting are advised. Smallholder households can benefit from biodigesting to generate biogas for domestic use. Meanwhile, medium-sized households are encouraged to adopt biodigesting not only for domestic consumption but also for selling surplus biogas. Additionally, vermicomposting is recommended for medium-sized households to enhance soil fertility.

Table 8.4: Manure management by household categories

Household categories	Area of intervention		
	Feed	Breed	Cow dung
Marginal	No	No	○ Storing in a 50 kg closed box and selling ○ Composting
Smallholder	No	Opting for artificial insemination	○ Storing in a 50 kg closed box and selling ○ Composting ○ Biodigesting for producing biogas to serve domestic facilities
Medium	Yes	Opting for crossbred	○ Integrated manure management system: ○ Biodigesting for producing biogas to serve whole farm facilities and selling the excess ○ Vermicomposting

8.7 GOVERNMENT-LEVEL CONSULTATION

- Consult with government officials especially with Department of Livestock Services (DLS) and Bangladesh Bureau of Statistics (BBS)) if there is any plan to change in the modality of estimation of national meat and milk production and productivity. The project should use the same estimation techniques.

- Think about how disaggregation of cattle population can be done on a larger scale. This will be required to estimate national GHG emissions.

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ANNEXES

ANNEX-A1

Annex-A1: Table 2.1: List of all indicators

Sl#	Indicator	Product	Category	Unit	Baseline value (2024)
1	Value of annual sales of farms and firms receiving USDA assistance	Milk-Cow ('000) (n=467)	All	USD	256
			Local	USD	36
			Crossbred	USD	220
		Milk-Cow ('000) (n=467)	All		256
			Urban	USD	52
			Rural	USD	204
		Carcass-Cattle ('000) (n=1753)	All	USD	915
			Local	USD	250
			Crossbred	USD	664
		Carcass-Goat (n=1753)		USD	46
		Grand Total			1,217
2	Volume of commodities sold by farms and firms receiving USDA assistance	Milk-Cow (n=467)	All	MT	588
			Local	MT	82
			Crossbred	MT	506
		Carcass-Cattle (n=1753)	All	MT	160
			Local	MT	44
			Crossbred	MT	116
		Carcass-Goat (n=1753)		MT	5
		Grand Total		MT	753
3	Yield of targeted agricultural commodities among project participants with USDA assistance	Milk-Cow (n=467)	All	liter/cow/lactation	1,164[29]
			Local	liter/cow /lactation	369
			Crossbred	liter/cow /lactation	1,746

[29] Average of local and crossbred types

Sl#	Indicator	Product	Category	Unit	Baseline value (2024)
		Carcass-Cattle (n=1753)	All	kg/cattle/year	96
			Local	kg/cattle/year	78
			Crossbred	kg/cattle/year	107
		Carcass-Goat (n=1753)		kg/cattle/year	7
4	Number of hectares under improved management practices or technologies that promote improved climate risk reduction and/or natural resources management with USDA assistance	N/A (n= 467)		Hectare	6.5
5	Number of individuals in agriculture system who have applied improved management practices or technologies with USDA assistance	N/A (n= 467)		Number	198
6	Number of hectares under improved management practices or technologies with USDA assistance	N/A (n= 467)		Hectare	6.5 (0.033 hectares/HH
7	Percentage decline in calf mortality rate a result of USDA assistance	N/A		Percent	5.2
8	Percentage of cattle and goats vaccinated as a result of USDA assistance	N/A	All	Percent	4.7
			Cattle	Percent	6.0
			Goat	Percent	1.7
9	GHG emissions eliminated, per unit produced (emission intensity) with USDA assistance	N/A	Milk	CO2e/kg	2.7
			Cattle	CO2e/kg	11.2
			Goat	CO2e/kg	14.6
10	Percentage of targeted livestock producers who are satisfied with the livestock services received from service providers	N/A		Percent	10
11	Percent utilization of installed processing capacity by participating firms as a result of USDA assistance	N/A		Percent	Milk 56.3
12	Number of jobs attributed to USDA assistance	N/A	N/A	Number	0

Sl#	Indicator	Product	Category	Unit	Baseline value (2024)
13	Number of individuals who have received short-term agricultural sector productivity or food security training as a result of USDA assistance	N/A	N/A	Number	0
14	Number of individuals participating in USDA food security programs	N/A	N/A	Number	0
15	Number of individuals benefiting indirectly as a result of USDA Assistance	N/A	N/A	Number	0
16	Percentage of farmers with increased incomes from livestock production as a result of USDA assistance	N/A	N/A	Percent	0
17	Number of people supported by the USDA to adapt to the effects of climate change	N/A	N/A	Number	0
18	Percentage of participants in USG-assisted programs designed to increase access to productive economic resources who are youth (15-29)	N/A	N/A	Percent	0
19	Percentage of female participants in USG-assisted programs designed to increase access to productive economic resources	N/A	N/A	Percent	0
20	Number of technologies, practices, and approaches under various phases of research, development, and uptake as a result of USDA assistance	N/A	N/A	Number	0
21	Number of livestock service providers providing services to cattle and goat producers with USDA assistance	N/A	N/A	Number	0
22	Number of individuals accessing agriculture-related financing or credit as a result of USDA assistance	N/A	N/A	Number	0
23	Number of loans disbursed as a result of USDA assistance	N/A	N/A	Number	0

Sl#	Indicator	Product	Category	Unit	Baseline value (2024)
24	Value of agriculture-related financing or credit accessed as a result of USDA assistance	N/A	N/A	USD	0
25	Number of public private partnerships formed as a result of USDA assistance	N/A	N/A	Number	0
26	Number of organizations with increased performance improvement with USDA assistance	N/A	N/A	Number	0
27	Number of organizations and firms supported with USDA assistance	N/A	N/A	Number	0
28	Number of individuals and firms with increased access to improved market information with USDA assistance	N/A	N/A	Number	0
29	Value of new USG commitments and new public and private sector investment leveraged by USDA	N/A	N/A	USD	0
30	Number of policies, regulations and/or administrative procedures in each of the following stages of development as a result of USDA assistance	N/A	N/A	Number	0
31	Number of smallholder meat and dairy producers and milk collectors linked to large meat and dairy processors with USDA assistance	N/A	N/A	Number	0

Annex-A1: Table 2.2: Focus Group Discussion (FGD) with producer groups and individual farmers

SL	Tools	Date	Type	District	Male	Female	Total
1	FGD	2024-07-02	Producer Group	Rajshahi	0	10	10
2	FGD	2024-07-03	Individual Farmers	Rajshahi	3	7	10
3	FGD	2024-07-08	Individual Farmers	Noagaon	4	12	16
4	FGD	2024-07-15	Producer Group	Noagaon	0	14	14
5	FGD	2024-07-24	Individual Farmers	Joypurhat	0	14	14
6	FGD	2024-07-25	Producer Group	Joypurhat	5	7	12
7	FGD	2024-07-27	Producer Group	Natore	6	5	11
8	FGD	2024-07-28	Individual Farmers	Natore	9	3	12
9	FGD	2024-07-02	Individual Farmers	Pabna	2	8	10
10	FGD	2024-07-06	Producer Group	Pabna	3	8	11
11	FGD	2024-07-09	Producer Group	Kushtia	3	7	10
12	FGD	2024-07-10	Individual Farmers	Kushtia	4	6	10
13	FGD	2024-07-13	Individual Farmers	Chuadanga	2	9	11
14	FGD	2024-07-15	Producer Group	Chuadanga	7	5	12
15	FGD	2024-07-26	Individual Farmers	Jamalpur	11	3	14
16	FGD	2024-07-27	Producer Group	Jamalpur	3	11	14
17	FGD	2024-07-01	Producer Group	Gaibandha	5	5	10
18	FGD	2024-07-01	Individual Farmers	Gaibandha	4	6	10
19	FGD	2024-07-08	Producer Group	Rangpur	4	6	10
20	FGD	2024-07-10	Individual Farmers	Rangpur	4	6	10
21	FGD	2024-07-16	Individual Farmers	Kurigram	5	5	10
22	FGD	2024-07-24	Producer Group	Kurigram	5	5	10
23	FGD	2024-07-01	Producer Group	Bogura	3	7	10
24	FGD	2024-07-03	Individual Farmers	Bogura	5	5	10
25	FGD	2024-07-15	Individual Farmers	Sirajganj	5	5	10
26	FGD	2024-07-17	Producer Group	Sirajganj	5	5	10
27	FGD	2024-07-02	Individual Farmers	Satkhira	10	0	10
28	FGD	2024-06-30	Producer Group	Satkhira	2	8	10
29	FGD	2024-07-13	Producer Group	Jashore	0	10	10
30	FGD	2024-07-07	Individual Farmers	Jashore	0	10	10
31	FGD	2024-07-19	Individual Farmers	Jhenaidah	10	0	10
32	FGD	2024-07-17	Producer Group	Jhenaidah	6	4	10
				Total	135	216	351
				Percent	38.46	61.54	100

Annex-A1: Table 2.3: List of Key Informant Interviews (KIIs) with stakeholders

Sl. No.	Date	Context	Source	Phone Number	Total KII
1	2024-07-02	Producer organizations and other livestock farmers	Rajshahi District	-	18
2	2024-07-10	Producer organizations and other livestock farmers	Naogaon District	01723840340	
3	2024-07-25	Producer organizations and other livestock farmers	Joypurhat District, Kalai, Punot union	01736203218	
4	2024-07-27	Producer organizations and other livestock farmers	Joypurhat District, Kalai, Boro Horishpur union	01724300429	
5	2024-07-28	Producer organizations and other livestock farmers	Natore District	-	
6	2024-07-10	Producer organizations and other livestock farmers	Pabna District	0174040512	
7	2024-07-08	Producer organizations and other livestock farmers	Kushtia District, Bheramara, Gachua	01726747737	
8	2024-07-03	Producer organizations and other livestock farmers	Kushtia District, Haripur Dairy PG	-	
9	2024-07-14	Producer organizations and other livestock farmers	Chuadanga District	01716474581	
10	2024-07-27	Producer organizations and other livestock farmers	Jamalpur District	01768905144	
11	2024-07-01	Producer organizations and other livestock farmers	Gaibandha District	-	
12	2024-07-10	Producer organizations and other livestock farmers	Rangpur District	01718938213	
13	2024-07-24	Producer organizations and other livestock farmers	Kurigram District	01911644269	
14	2024-07-08	Producer organizations and other livestock farmers	Bogrua District	01745628893	
15	2024-07-14	Producer organizations and other livestock farmers	Sirajganj District, Betua	01774352003, 01759137672	
16	2024-07-03	Producer organizations and other livestock farmers	Satkhira District	01713902303	
17	2024-07-09	Producer organizations and other livestock farmers	Jashore District	01737633958	
18	2024-07-15	Producer organizations and other livestock farmers	Jhinaidah District	01715585723	
19	2024-07-24	Processors	Jamalpur District	01920963948	10
20	2024-07-14	Processors	Chuadanga District	01715444257	

Sl. No.	Date	Context	Source	Phone Number	Total KII
21	2024-07-18	Processors	Sirajganj District, Ullapara, Magura Danga	01795033260	
22	2024-07-16	Processors	Sirajganj District, Shahjadpur	01798344784	
23	2024-07-18	Processors	Sirajganj District, Bakhuya	01962615932	
24	2024-07-18	Processors	Sirajganj District, Ullapara, Shamoly Para	01734168131	
25	2024-07-17	Processors	Sirajganj District, Ullapara, R.P. Agro	01774352003, 01759137672	
26	2024-07-06	Processors	Jashore District	01733174158, 01799967644	
27	2024-07-24	Processors	Kurigram District	01717935772	
28	2024-07-02	Processors	Natore District	01715139025	
29	2024-07-20	Extension services providers	Upazila Livestock Officer (ULO), Manda, Naogaon	01743669945	8
30	2024-07-04	Senior officials of other government institutions (MoFL,/ DLS,/ MoEFCC, / DAE, and local research institutions and universities)	Former Director General, BLRI		
31	2024-07-08	Extension services providers	Upazila Livestock Officer (ULO), Bheramara, Kushtia	01324289618, 01752854707	
32	2024-07-18	Extension services providers	Upazila Livestock Officer (ULO), Islampur, Jamalpur	01324290113, 01712505708	
33	2024-07-17	Extension services providers	Upazila Livestock Officer (ULO), Jhinaidah	01716151237	
34	2024-07-10	Extension services providers	Upazila Livestock Officer (ULO), Jashore	01914650550	
35	2024-07-04	Extension services providers	Upazila Livestock Officer (ULO), Bogura	01717432311	
36	2024-07-16	Extension services providers	Upazila Livestock Officer (ULO), Kurigram	01724018835	
37	2024-09-26	Research institutions working on livestock commodities	Principal Scientist, Bangladesh Agricultural Research Council (BARC)	01723478515	2

Sl. No.	Date	Context	Source	Phone Number	Total KII
38	2024-09-22	Research institutions working on livestock commodities	Principal Scientific Officer, Central Disease Investigation Laboratory (CDIL), DLS	01716940769	
39	2024-09-23	Large buyers and exporters of livestock commodities	PRAN Dairy	01704132093	4
40	2024-09-23	Large buyers and exporters of livestock commodities	BENGAL MEAT	01714097416	
41	2024-09-24	Large buyers and exporters of livestock commodities	Krishibid	01896266423	
42	2024-09-24	Large buyers and exporters of livestock commodities	Deputy Manager, MILK VITA	01711987179	
43	2024-07-02	Input dealers	ACI, Naogaon	01740556086	6
44	2024-07-13	Input dealers	Feed & Medicine, Sirajganj	01712282283, 01972282283	
45	2024-07-17	Input dealers	Livestock Materials, Jamalpur	01943917257	
46	2024-07-13	Input dealers	Veterinary Pharmacy, Chuadanga	-	
47	2024-07-02	Input dealers	Feed & Medicine, Shyamnagar	01781377177	
48	2024-07-08	Input dealers	Livestock Materials, Rangpur	01733142577	
49	2024-07-09	Financial institutions	Palli Sanchoy Bank, Jashore	01938879178	4
50	2024-07-31	Financial institutions	National Bank, Shyamnagar	01717473112	
51	2024-07-02	Financial institutions	BRAC	01721700594	
52	2024-07-15	Financial institutions	CARB, Naogaon	01732689513	
53	2024-09-19	Senior officials of other government institutions (MoFL,/ DLS,/ MoEFCC, / DAE, and local research institutions and universities)	Director, Production, Dept. of Livestock Services (DLS)	01716001137	4
54	2024-09-22	Senior officials of other government institutions (MoFL,/ DLS,/ MoEFCC, / DAE, and local research institutions and universities)	Principle Scientific Officer, Livestock Research Institute (LRI)	01711820447	

Sl. No.	Date	Context	Source	Phone Number	Total KII
55	2024-09-23	Senior officials of other government institutions (MoFL,/ DLS,/ MoEFCC,/ DAE, and local research institutions and universities)	Senior Assistant Director, Medicine Store, LRI	01675695869	
56	2024-09-23	Senior officials of other government institutions (MoFL,/ DLS, / MoEFCC, / DAE, and local research institutions and universities)	Senior Upazila Livestock Officer, Gazaria, Munshiganj	01712892275	
57	2024-09-24	Other potential implementing partners	Srijan, Agrogoti	01828338126	2
58	2024-09-22	Other potential implementing partners	ICRA project, Islamic Relief Bangladesh	01777773862	
59	2024-09-23	ICT firms and other business service providers	NVANA Pharmaceuticals	01321130028	3
60	2024-09-22	ICT firms and other business service providers	Dealer- Artificial insemination	01790744238	
61	2024-09-19	ICT firms and other business service providers	DLO, ICT Section, Dept. of Livestock Services (DLS)	01715138766	
62	2024-09-19	Local service provider (LSP)	Bogura District	01317702355	1
63	2024-09-19	Local service provider (LSP)	Bogura District	01716028479	1

Annex-A1: Table 3.1: District-wise educational disparities

Districts	No formal education	1 – 5 years of formal education	6 – 10 years of formal education	11 + years of formal education	Grand Total
Bogura	32	31	20	17	100
Chuadanga	41	30	21	7	100
Gaibandha	32	34	21	13	100
Jamalpur	49	24	17	9	100
Jashore	25	40	19	16	100
Jhenaidah	31	34	19	16	100
Joypurhat	23	41	18	17	100
Kurigram	34	31	22	13	100
Kushtia	48	28	16	8	100
Noagaon	28	37	21	15	100
Natore	29	38	19	15	100

Districts	No formal education	1 – 5 years of formal education	6 – 10 years of formal education	11 + years of formal education	Grand Total
Pabna	36	34	21	9	100
Rajshahi	26	32	25	16	100
Rangpur	33	34	20	13	100
Satkhira	27	38	22	12	100
Sirajganj	34	31	20	16	100
Grand Total	32	34	20	14	100

Annex-A1: Table 3.2: Primary income sources status of surveyed households

BCSL interest	Primary income source	Number	Percentage
Direct	Cattle rearing	161	9.2
Direct	Farming- fodder cultivation	22	1.3
Direct	Goat rearing (only goat)	1	0.1
Direct	Business: livestock input seller	2	0.1
Direct	Processors (sweets, curd, ghee, cheese, butter, etc.)	2	0.1
Direct	Milk collector	3	0.2
Direct	Veterinarian	6	0.3
Direct - All		197	11.2
Indirect	Farming- other than fodder cultivation (own land)	641	36.6
Indirect	Sharecropper	69	3.9
No	Agricultural day labor/ contract labor	252	14.4
No	Fishing (own boat)	2	0.1
No	Fishing labor (someone else's boat)	1	0.1
No	Fish farming (aquaculture)	7	0.4
No	Poultry	4	0.2
No	Regular salaried employment	146	8.3
No	Traders (small business)	279	15.9
No	Paid 'volunteers'	3	0.2
No	Tuition	2	0.1
No	Servant/ maid	1	0.1
No	LSP	1	0.1
No	Income from foreign	28	1.6
No	Rickshaw/ Van/ Auto Driver	87	5.0
No	Income from Gher	15	0.9
No	Others	18	1.0
	All	1,753	100

Annex-A1: Table 3.3: Average yearly income by district and source

District	Average of total income from livestock BDT	Average of Total Income BDT	Percentage from livestock
Bogura	115,246	337,394	34
Chuadanga	116,932	320,709	36
Gaibandha	137,558	308,248	45
Jamalpur	91,223	323,313	28
Jashore	193,785	458,419	42
Jhenaidah	364,856	648,213	56
Joypurhat	159,382	287,497	55
Kurigram	98,306	318,261	31
Kushtia	96,361	316,865	30
Noagaon	88,941	236,606	38
Natore	218,231	426,064	51
Pabna	244,365	408,095	60
Rajshahi	86,920	251,718	35
Rangpur	109,677	332,222	33
Satkhira	73,820	431,634	17
Sirajganj	206,837	469,574	44
Grand Total	160,948	373,784	43

Annex-A1: Table 3.4: Household category-wise household head (as percentage)

Household categories	Male-headed	Female-headed
Marginal	95.4	4.6
Smallholder	96.9	3.1
Medium	94.4	5.6
All	95.7	4.3

Annex-A1: Table 3.5: Household wise role-players (as percentage)

Household categories	Male	Female	Jointly
Marginal	34.6	47.1	18.3
Smallholder	33.2	50.4	16.5
Medium	33.3	48.1	18.5
All	34.2	47.9	17.9

ANNEX-A2

Attached as a separate file, which is an integral part of the main report, are the following items:

1. Study Terms of Reference (ToR)
2. Baseline Survey Questionnaire
3. Focus Group Discussion (FGD)
4. Key Informant Interview (KII) Checklist
5. Study Timeline
6. General Approach and Survey Methodology