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Agro-Logistics System Mapping

Stocktaking Exercise on Agro-Logistics in Bangladesh

INNOVISION
Research | Technical Assistance | Project Management

For Embassy of the Kingdom of the Netherlands (EKN) | Innovision Consulting Private Limited
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Final Report

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Short Brief

This report presents a comprehensive system mapping and diagnostic assessment of Bangladesh's agro-logistics ecosystem, commissioned by the Embassy of the Kingdom of the Netherlands (EKN). The study examines structural inefficiencies, post-harvest losses, infrastructure gaps, and market constraints across four priority sub-sectors: horticulture, fisheries, livestock, and cereals.

Acronyms

ADB – Asian Development Bank

APHA – Animal and Plant Health Agency (UK)

APHIS – Animal and Plant Health Inspection Service (USA)

a2i – Aspire to Innovate (Government Digital Initiative, Bangladesh)

BAMIS – Bangladesh Agricultural Market Information System

BAPA – Bangladesh Agro-Processors Association

BARC – Bangladesh Agricultural Research Council

BARI – Bangladesh Agricultural Research Institute

BAP – Best Aquaculture Practices

BBS – Bangladesh Bureau of Statistics

BDT – Bangladeshi Taka

BFDC – Bangladesh Fisheries Development Corporation

BFFEA – Bangladesh Frozen Foods Exporters Association

BFSA – Bangladesh Food Safety Authority

BFRI – Bangladesh Fisheries Research Institute

BRI – Belt and Road Initiative

BSTI – Bangladesh Standards and Testing Institution

CAAB – Civil Aviation Authority of Bangladesh

CAGR – Compound Annual Growth Rate

CUTS – Consumer Unity & Trust Society (CUTS International)

DAM – Department of Agricultural Marketing

DAE – Department of Agricultural Extension

DLS – Department of Livestock Services

DoF – Department of Fisheries

EKN – Embassy of the Kingdom of the Netherlands

EPB – Export Promotion Bureau

EU – European Union

EUS – Epizootic Ulcerative Syndrome

FAO – Food and Agriculture Organization (United Nations)

FIQC – Fish Inspection and Quality Control

FPMU – Food Planning and Monitoring Unit

FY – Fiscal Year

GAP – Good Agricultural Practices

GCC – Gulf Cooperation Council

GDP – Gross Domestic Product

HACCP – Hazard Analysis and Critical Control Points

IFC – International Finance Corporation

IQF – Individually Quick Frozen

IPCC – Intergovernmental Panel on Climate Change

IPH – Institute of Public Health

JICA – Japan International Cooperation Agency

KII / KIIs – Key Informant Interview(s)

LDC – Least Developed Country

LGED – Local Government Engineering Department

MMT – Million Metric Tons

MoA – Ministry of Agriculture

MoC – Ministry of Commerce

MoF – Ministry of Finance

MoFL – Ministry of Fisheries and Livestock

MoT – Ministry of Transport

MRL – Maximum Residue Limit

MSC – Mediterranean Shipping Company

MT – Metric Ton

NACA – Network of Aquaculture Centers in Asia-Pacific

OECD – Organization for Economic Co-operation and Development

OSS – One-Stop Service

Acronyms

PKSF – Palli Karma-Sahayak Foundation

PL – Post-Larvae

PPP – Public-Private Partnership

PQW – Plant Quarantine Wing

RHD – Roads and Highways Department

RPC – Returnable Plastic Crates

RVO – Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland)

SAFTA – South Asian Free Trade Area

SME – Small and Medium Enterprise

SPS – Sanitary and Phytosanitary

SPF – Specific Pathogen Free

SREDA – Sustainable and Renewable Energy Development Authority

TEU – Twenty-foot Equivalent Unit

UNIDO – United Nations Industrial Development Organization

USAID – United States Agency for International Development

USDA – United States Department of Agriculture

USTDA – United States Trade and Development Agency

VHT – Vapour Heat Treatment

VAT – Value Added Tax

WBG – World Bank Group

WOAH – World Organization for Animal Health

WSSV – White Spot Syndrome Virus

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Executive Summary

Bangladesh has largely succeeded in raising agricultural production. However, the country's binding constraint is no longer production; it is **post-harvest management, logistics efficiency, and market integration.** Across horticulture, fisheries, livestock, and cereals, **20–40% of perishable output is lost post-harvest**, translating into billions of dollars in economic leakage, reduced farmer incomes, food safety risks, and weakened export competitiveness. Infrastructure investments have improved connectivity and speed, but **quality-preserving logistics systems remain underdeveloped.**

This system mapping exercise identifies where value is lost, why it is lost, and which interventions yield the highest return for public and private investment.

National Agro-Logistics Context

Bangladesh does not face a production crisis. It faces a **preservation, coordination, and market systems crisis.**

Core Insight:

- Agriculture contributes **~11–12% of GDP** but employs **over 43% of the labor force,** underscoring its poverty and food security relevance.
- Cold storage capacity is heavily skewed: **over 90% is dedicated to potatoes,** leaving fruits, vegetables, fish, meat, and dairy largely underserved.
- Less than **2% of agricultural transport is refrigerated.**
- Logistics costs are estimated at **15–20% of GDP,** among the highest in Asia.
- Supply chains remain fragmented and intermediary-dominated, limiting farmer price realization.

Policy momentum exists (National Logistics Policy, SPS upgrades, digitalization initiatives), but implementation remains production-focused rather than post-harvest focused.

Sectoral Findings

A. Horticulture (Fruits & Vegetables)

Horticulture shows strong production growth but experiences the **highest losses (20–44%)**, driven by:

- Short shelf life and extreme seasonality
- Weak first-mile handling
- Bamboo sacks and non-standard packaging
- Absence of a multi-commodity cold chain
- Congested wholesale markets

Price spreads between farm-gate and retail commonly reach **200–300%**, reflecting inefficiencies rather than value addition.

Estimated annual economic losses: **USD 1.3–2.6 billion.**

Export growth (e.g., mango, vegetables) is constrained by:

- Limited packhouses
- Inadequate temperature-controlled airport handling
- SPS and residue testing gaps

High-Return Priorities:

- First-mile handling and plastic crate systems
- Multi-commodity packhouses in production clusters
- Wholesale market modernization
- Export cold chain continuity.

B. Fisheries

Fisheries contribute **2.5% of GDP** and are Bangladesh's primary animal protein source. Losses are estimated at **20–25%**, driven more by quality degradation than visible spoilage.

- Shrimp exports are relatively formalized but constrained by upstream delays, disease, and seed system weaknesses.
- Domestic fish chains (carp, pangasius, tilapia, hilsa) rely almost entirely on **ice-based systems.**
- Cold chain penetration outside shrimp is **<5%.**

• Hilsa and shrimp incur the highest per-ton value loss due to premium pricing and temperature sensitivity.

Estimated economic loss: **>USD 150 million annually.**

High-Return Priorities:
• First-mile icing and insulated transport
• Wholesale cold buffering
• Shrimp SPF hatchery expansion
• Market digitalization and reduction of informal credit (dadon) dependency.

C. Livestock
Bangladesh has achieved meat self-sufficiency, yet agro-logistics constraints dominate outcomes:
• **70–90% of transactions remain informal**
• Cold chain penetration: ~10% (dairy), <7% (meat)
• Live-animal transport stress reduces weight and value
• Informal slaughter creates hygiene and traceability risks

Seasonal shocks (e.g., Eid-ul-Azha) overwhelm transport and slaughter capacity.

Export potential remains negligible due to:
• Absence of disease-free certification
• Weak halal compliance systems
• Limited processing and cold chain capacity

High-Return Priorities:
• First-mile milk chilling
• Hygienic slaughter and processing facilities
• Market modernization and traceability

D. Cereals
Cereals face lower perishability but still incur significant losses at:
• First-mile drying
• Aggregation and storage
• Transport and port handling
• Infrastructure exists but is misaligned with loss hotspots.

High-Return Priorities:
• Drying and storage modernization
• Improved integration between farm-level handling and milling
• Port logistics efficiency.

Cross-Sector Systemic Constraints

Across all sub-sectors, five recurring structural bottlenecks emerge:
1. **First-Mile Failure:** Quality deterioration begins immediately after harvest, landing, or milking.
2. **Cold Chain Misalignment:** Downstream capacity exists (especially in shrimp), but early-stage cooling is absent.
3. **Fragmented Intermediary-Dense Chains:** Multiple handovers increase damage and suppress producer margins.
4. **Wholesale Market Congestion:** Delays at arats and wet markets amplify spoilage and value erosion.
5. **Weak SPS and Traceability Systems:** Export readiness is uneven, particularly post-LDC graduation (2026).

Economic Implications

Reducing post-harvest losses by **25–50%** could:
• Increase effective food availability equivalent to **~15% production growth without land expansion**
• Raise farm-gate incomes
• Reduce price volatility
• Improve food safety
• Strengthen export competitiveness

Loss reduction is therefore both **a food security intervention and a macroeconomic efficiency strategy.**

Strategic Considerations

Bangladesh stands at an inflection point. Production growth has plateaued as the primary driver of agricultural transformation. The next frontier is **logistics modernization, loss reduction, and market system reform.**

- Focus on **early-stage loss prevention,** not end-stage refrigeration.
- Align infrastructure with **geographic production clusters.**
- Use PPPs to crowd in private capital where commercial viability exists.
- Support institutional coordination across DAE, DoF, DLS, DAM, and SPS authorities.
- Prepare the sector for **post-LDC graduation trade realities.**

Strategic investments in first-mile handling, cold chain integration, market infrastructure, and export compliance could convert systemic value loss into inclusive growth, strengthening food security, farmer incomes, and trade competitiveness simultaneously.

01

Introduction

Bangladesh agricultural sector is significantly constrained by high post-harvest losses, weak logistics infrastructure, limited cold chain penetration, and fragmented formal and informal supply chain operations (Kumar et al, 2012). These challenges severely limit the sector's efficiency, resilience, and competitiveness in the domestic and international agro-food systems.

High Post-Harvest Losses and Perishability Issues: The inherent perishability of agro-products, particularly fruits, vegetables, fish, and meat, directly leads to substantial post-harvest losses (Chowdhury, 2012). The physical loss is amplified by the poor state of the current supply chain management for perishable goods (Sujoya, 2023). These losses are a major industry issue and pose a fundamental challenge to food safety and farmer incomes.

Weak Logistics Infrastructure: Deficiencies in infrastructure are a key challenge to the sustainability of perishable food cold-chain logistics (Zhang & Mohammad, 2024). While Bangladesh has made efforts to expand its cold chain infrastructure to preserve fish, meat, dairy, and horticultural products, significant gaps remain (Ahmed et al., 2025).

Limited Cold Chains: The lack of cold chain facilities at the farm level is particularly noted as a challenge that must be mitigated. The general lack of cold chain facilities for perishable foods in the developing world is a systemic issue, and cold chain development has historically faced hurdles in Bangladesh (Yahia, 2014). Furthermore, external factors, such as large-scale disruptions (e.g., severe weather or political instability), can disrupt supply chains, delaying the movement of perishable goods and impacting the overall resilience of the supply chain (Aziz et al., 2025).

Fragmented Supply Chain Operations: The existing horticultural supply chain is plagued by various issues. The complex, multi-layered nature of distribution for perishable foods in urban Bangladesh makes effective supply chain management difficult. This fragmentation contributes to operational inefficiencies and makes the entire chain vulnerable to disruptions. Developing a conceptual framework for effective perishable food cold-supply-chain management is essential to address these industry issues. The adoption of cold chains has been shown to offer a higher return for perishable products compared to traditional supply chains (Islam et al., 2022).

To systematically address these issues and improve the efficiency, resilience, and competitiveness of the agro-food systems, the Embassy of the Kingdom of the Netherlands (EKN) commissioned a critical stocktaking exercise on the Agro-Logistics in Bangladesh. The assignment carried out by Innovision Consulting has focused on the Agro-Logistics System Mapping component.

1.1. Objectives

The primary objective of this system mapping component is to generate a **comprehensive, actionable overview** of the logistics ecosystems for Bangladesh's key agro-commodities. The study is designed to move from descriptive mapping to diagnostic analysis, providing a clear evidence base for public and private sector action.

Specific objectives include:

• **Map End-to-End Supply Chain Flows:** Document the physical movement and transformation of key commodities, horticulture, dairy, poultry, fisheries, cereals, and livestock, from production to consumption/export, highlighting critical nodes and handoff points.

• **Identify Formal and Informal Logistics Channels:** Analyze both structured and unstructured pathways for input delivery and product marketing, assessing their relative efficiency, cost, and prevalence.

• **Assess Logistics Infrastructure:** Evaluate the availability, capacity, utilization, and geographic distribution of critical infrastructure, including cold storage, warehouses, packhouses, transport networks, networks, and wholesale markets.

- **Profile Key Supply Chain Actors:** Catalogue and characterize the roles, interactions, incentives, and pain points of farmers, traders, processors, exporters, logistics service providers, and regulators.

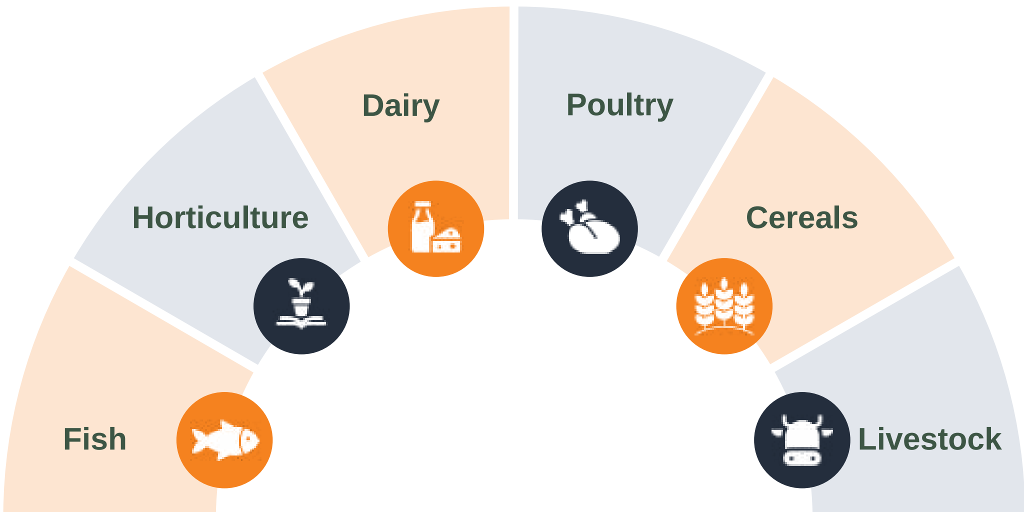
- **Identify Systemic Bottlenecks and Barriers:** Diagnose the root causes of inefficiencies, including operational, regulatory, financial, and infrastructural constraints, as well as tariff and non-tariff barriers to trade.

- **Generate Evidence for Strategic Intervention:** Synthesize findings to provide a robust foundation for prioritizing policy recommendations, investment opportunities, and technical assistance programs to enhance system performance.

This report constitutes the final output of this comprehensive mapping exercise, integrating primary and secondary data to present a clear roadmap for transforming Bangladesh's agro-logistics landscape.

1.2 Scope of Work

Commodities



Nodes of the Chain

Production → Aggregation → Storage → Processing → Transport → Wholesale → Retail → Export

Logistics Functions

Input movement, storage, packaging, cold chain, handling, transport

Geographic Coverage

National, with specific focus on high-production clusters and key logistics corridors

Actors

Formal & informal farmers, traders, processors, government regulators, exporters, logistics service providers

02

Methodology

Our approach to mapping the agro-logistics system combines **desk research, qualitative stakeholder consultations,** and **triangulation across data sources.** The methodology is designed to capture both **formal and informal logistics systems,** identify structural and operational bottlenecks, and assess investment and policy leverage points across priority agri-food value chains.

A. Secondary Data

The study draws on a comprehensive review of secondary sources, including:

• Government documents and regulatory frameworks (MoA, MoFL, MoC, DAE, DoF, BFSA, BSTI)
• Reports and datasets from FAO, BBS, World Bank Group (WBG), IFC
• Sector diagnostics and learning from previous Dutch-supported and other donor projects
• Customs, trade, and export data
• Relevant scientific literature and grey literature on post-harvest management, cold chain, and agri-logistics.

B. Primary Consultations

A total of **21 Key Informant Interviews (KIIs)** were conducted with government agencies, research institutions, industry associations, agribusinesses, logistics providers, producer-aggregators, and digital platforms to capture system-wide perspectives on agro-logistics performance, bottlenecks, and investment opportunities.

Table 1: Key Informant Interviews (KIIs) Conducted for Agro-Logistics System Mapping

Category	Organization / Location	Designation / Role	Purpose
Government Agencies & Public Institutions	DAE, Pack House	Quarantine Entomologist	Regulatory frameworks, inspection and certification processes, export logistics, market information systems, and public-sector constraints affecting agro-logistics
	DAE, Quarantine Wing	Deputy Director (Export)	
	DAE, Quarantine Wing	Quarantine Pathologist (Import)	
	Department of Agricultural Marketing (DAM)	Deputy Secretary, Market Information & Statistics	
	Department of Fisheries (DoF)	Ex-Deputy Director, Quality Control	
	DAE, Mango Export Project	Project Director	
	BAU, Dept. of Fisheries Technology	Professor	
Research, Technical & Sector Experts	BARI, Postharvest Technology Division	Principal Scientific Officer	Technical insights on post-harvest handling, cold chain design, loss reduction, and feasibility of logistics upgrades across horticulture and fisheries value chains
	Ex-WorldFish	Aquaculture Specialist & Producer	
	Ex-Hortex Foundation	Agro-processing Expert	

	BAU	Professor, Fisheries Technology	
Industry Associations & Foundations	Bangladesh Agro-Processors Association (BAPA)	Project Manager	Sector-wide perspectives on logistics constraints, coordination failures, investment gaps, and policy priorities
	Tilapia Foundation	General Secretary	
Agribusinesses, Exporters & Processors	Hanay FoodsPro Ltd	Managing Director	Export logistics pathways, compliance requirements, cold chain usage, processing constraints, and private-sector investment considerations
	Kisan Botanix	General Manager	
	Fardin International & BD Fresh Exotics Global	Manager	
	Nawabi Mango	Proprietor	
	Shrimp Producer	Producer	
Logistics Providers, Aggregators & Digital Platforms	TRANSMOVE	Chief Executive Officer	Transport and cold chain service provision, aggregation and last-mile logistics models, digital enablement of agri-logistics, and scalability constraints
	iFarmer	VP – Field Operations	
	Chaldal (Online Grocery Platform)	Chief of Staff	
Producers & Producer-Aggregators	Entrepreneur, Rajshahi	Mango Producer & Aggregator	Ground-level logistics practices, informal aggregation systems, handling losses, and producer-level constraints
	Shrimp Farm	Commercial Producer	
	Independent	Producer-Practitioner	

03

National Agro-Logistics Context

3.1 Overview of Bangladesh’s Agricultural Sector

Agriculture remains a foundational pillar of Bangladesh’s economy, food security, and rural employment, even as the country undergoes structural transformation toward industry and services. As of FY2024–25, agriculture contributes approximately **11.2–11.7% of national GDP**, a share that has gradually declined over the past decade due to faster growth in manufacturing and services. Despite this relative decline, the sector continues to employ **around 43–44% of the national labor force**, highlighting its critical role in rural livelihoods, poverty reduction, and social stability (BBS, 2024; World Bank, 2024).

Production Trends and Structural Shifts

Bangladesh has made substantial progress in increasing agricultural output through yield improvements, irrigation expansion, and technology adoption. Total food grain production reached **approximately 50.1 million metric tons (MMT) in FY2023–24,** driven primarily by rice, which accounts for over 70% of cropped area and calorie intake (BBS, 2024; FPMU, 2024). Wheat and maize production have also increased, particularly maize, which is increasingly driven by feed demand from the livestock and poultry sectors.

Alongside staple grains, the agricultural sector is undergoing gradual diversification. High-value horticulture, such as mango, citrus, guava, vegetables, and spices, is expanding, supported by rising urban incomes, dietary diversification, and growing demand from export and diaspora markets. Between 2015 and 2024, horticultural output grew faster than cereals, although it remains far more vulnerable to post-harvest losses due to perishability and weak logistics (FAO, 2023; DAM, 2024).

Modernization and Digital Agriculture

The Government of Bangladesh has accelerated agricultural digitization as part of its broader “Smart Bangladesh” agenda. Nearly all registered farmers now hold digital farmer identification cards, enabling targeted subsidy delivery, crop input distribution, and access to extension services. **E-agriculture initiatives,** including digital weather advisories, pest alerts, soil fertility mapping, and mobile-based market price information, are being rolled out nationwide (MoA, 2023; a2i, 2024). While these initiatives have improved production planning, their impact on post-harvest decision-making and logistics coordination remains limited.

So, Bangladesh’s agricultural challenge is no longer primarily about increasing production, but about **moving, storing, and marketing** what is already produced efficiently and safely. Agro-logistics has become the binding constraint on farm income growth and food system efficiency.

3.2 Logistics and Infrastructure Landscape

Agro-logistics is widely recognized as the largest structural bottleneck in Bangladesh’s agricultural value chains. The system remains dominated by informal, ambient-temperature handling, with limited integration of cold storage, standardized packaging, or coordinated transport.

Cold Chain Capacity and Gaps

As of 2025, Bangladesh has an estimated 2.6–2.8 million metric tons of cold storage capacity, operated largely by the private sector. However, this capacity is highly specialized and unevenly distributed. More than 90% **of cold storage** facilities are designed exclusively for potatoes, reflecting historical price stabilization policies rather than diversified food system needs (World Bank, 2023; DAM, 2024).

Demand for cold storage, particularly for fruits, vegetables, fish, meat, and dairy, is estimated at 4.5 million MT or more, implying a shortfall of nearly **40%**. The absence of multi-commodity cold rooms and pre-cooling facilities contributes to post-harvest losses of **25–40%** in horticulture and perishables (FAO, 2022; World Bank, 2025).

Transport Infrastructure and Modal Constraints

Significant investments in national transport infrastructure have improved connectivity. Projects such as the Padma Bridge, Dhaka Elevated Expressway, and expanded national highways have reduced travel times between production regions and urban markets by **30–40%** (RHD, 2024). These improvements have enhanced physical access but have not translated into **quality-preserving logistics.**

Less than 1% of agricultural transport vehicles are refrigerated, and the vast majority of produce is transported in open trucks, buses, boats, or vans with ice or no temperature control. Packaging remains rudimentary, relying on bamboo baskets, sacks, and crates that cause compression damage and moisture loss (UNIDO, 2019; World Bank, 2023).

Thus, infrastructure expansion has focused on **speed**, not **preservation**. Without cold chain integration, faster transport often accelerates quality loss rather than preventing it.

3.3 Policy and Regulatory Environment

The policy environment governing agro-logistics is evolving rapidly in anticipation of Bangladesh's post-LDC graduation, expected to reshape trade preferences, export compliance requirements, and competitiveness.

National Logistics and Trade Facilitation Policies

The National Logistics Policy aims to reduce logistics costs, currently estimated at **15–20% of GDP,** among the highest in Asia, through multimodal transport development, digital customs clearance, and streamlined border procedures (MoC, 2023; World Bank, 2024). The expansion of the **One-Stop Service (OSS)** platform is intended to reduce delays for agro-exports and processors.

Food Safety, SPS, and Phytosanitary Regulation

Regulatory oversight has strengthened in recent years. The Bangladesh Food Safety Authority (BFSA) and the Plant Quarantine Wing have expanded inspection coverage, with thousands of food establishments graded annually and accredited laboratories established for **pesticide residue and SPS testing** (BFSA, 2024; PQW, 2024). These measures are critical for export readiness but remain weakly enforced in domestic wet markets.

Fiscal Support and Incentives

In FY2024–25, the government allocated approximately **BDT 250 billion (BDT 25,000 crore)** for agricultural subsidies, primarily for fertilizers, seeds, irrigation, and mechanization. Concessional credit schemes are available for agro-processors and cold storage investors, although uptake remains constrained by land, power, and financing challenges (MoF, 2024; Bangladesh Bank, 2024).

A deeper dive into the taxation in relation to cold chain aspects reveals that 1**5% VAT exemption is not automatic for all cold storage equipment**; it requires specific project registration as a food processing unit, but is also not restricted to a government list. Therefore, companies can benefit from these exemptions either by establishing local operations or by selling to Bangladeshi buyers who meet the eligibility requirements.

Overall, policy intent is strong, but implementation remains skewed toward production inputs rather than post-harvest systems, limiting overall impact.

3.4 Cross-cutting Challenges and Opportunities

Key Structural Challenges

Fragmentation of Production

Most farms operate on **0.5–2 hectares**, making it difficult to achieve scale efficiencies in storage, transport, and processing. Fragmentation increases per-unit logistics costs and discourages private investment in rural aggregation infrastructure (FAO, 2022).

Climate Vulnerability

Bangladesh's location in the **Ganges-Brahmaputra-Meghna Delta** exposes agriculture to floods, cyclones, salinity intrusion, and heat stress. Climate shocks increasingly disrupt harvest timing, transport routes, and storage conditions, compounding post-harvest losses (IPCC, 2022; BARC, 2023).

Intermediary-Dominated Markets

Due to weak direct market access, intermediaries capture 3**0–50% of the final consumer price**, particularly for perishables. This suppresses farm-gate prices and limits incentives for quality improvement (DAM, 2024; World Bank, 2023).

Strategic Opportunities

Agro-Processing Expansion

Only **around 12% of agricultural output is processed**, leaving significant scope to absorb seasonal surpluses into juice, dried fruit, frozen vegetables, flour, and feed products (FAO, 2023). Processing can stabilize prices, reduce losses, and create rural employment.

Diaspora and Niche Export Markets

Demand from the Middle East, EU, and UK for Bangladeshi fruits, vegetables, fish, and ethnic food products is growing. Meeting these markets requires improved logistics, traceability, and compliance, but offers high-value returns (EPB, 2024).

Digital Traceability and Market Integration

Digital platforms for traceability, e-trading, and logistics coordination can reduce transaction costs, improve transparency, and help exporters meet international MRL (Maximum Residue Limits) and SPS (Sanitary and Phytosanitary) requirements (UNIDO, 2023).

Bangladesh's agro-logistics system sits at a critical inflection point. Production gains have largely been achieved, infrastructure connectivity is improving, and policy momentum is building. Yet without **systematic investment in post-harvest handling, cold chain integration, and market modernization**, the country will continue to incur massive economic losses and miss opportunities for inclusive growth and export competitiveness. Chapter 3 establishes the national context in which the subsequent commodity-specific analyses must be understood.

04

System Mapping – Horticulture Sub-Sector (Fruits & Vegetables)

4.1. Sector Overview and Relevance of Selected Horticulture Products

The horticulture sector is a vital component of Bangladesh's agricultural economy, characterized by strong growth potential but constrained by persistent post-harvest and agro-logistics inefficiencies. The sector is dominated by smallholder farmers, typically cultivating 1–3 acres of land, and is marked by largely informal, fragmented production and marketing systems. These structural characteristics heighten vulnerability to post-harvest losses and limit value realization across the supply chain.

Bangladesh has achieved notable growth in horticulture production over the past decade. Total **vegetable production** increased from **3.87 million tons in FY2015–16 to 4.88 million tons in FY2023–24**, representing approximately 64% growth, while **fruit production** rose from **4.81 million tons to 5.99 million tons** over the same period (BBS, 2017; BBS, 2025). This expansion has been driven by yield improvements, varietal diversification, and rising domestic demand associated with population growth, urbanization, and changing consumption patterns. Despite these gains, the sector continues to experience high post-harvest losses, commonly estimated at 20–40% depending on the crop, largely due to inadequate handling, storage, transport, and market infrastructure.

For this study, eight horticultural commodities have been selected for in-depth analysis based on their production scale, degree of perishability, market importance, intensity of losses, and relevance to agro-logistics challenges. These include four vegetables and four fruits:

• **Vegetables**: Tomato, Potato, Cauliflower, Green Chili
• **Fruits**: Mango, Banana, Papaya, Watermelon

These crops represent a cross-section of the horticulture sector, encompassing high-volume staples critical to food security, nutritionally important vegetables, and fruits with growing domestic and export demand.

Collectively, the selected commodities capture the core logistical challenges facing Bangladesh's horticulture sector. They include short-shelf-life vegetables requiring rapid aggregation and distribution, crops dependent on cold storage and controlled release, high-value fruits with export potential necessitating specialized handling and ripening, and bulky seasonal produce that places acute pressure on transport and wholesale market systems. As such, these crops provide a robust basis for analyzing the structure, performance, and constraints of horticulture agro-logistics in Bangladesh.

4.2. Production Trend, Geography, Concentration, and Seasonality

4.2.1. Production Trend

The selected horticultural products exhibit varied production trajectories, reflecting both opportunities and vulnerabilities in the sector. The following table summarizes key trends in area under cultivation and production volumes, highlighting compound annual growth rates (CAGR) where applicable and notable observations.

Table 2: Area and Production Trend of Selected Horticulture Crops

Crop	Area Trend	Production Trend	Key Observation
Vegetables			
Tomato	Increasing	Increasing (~4–5% CAGR)	Expansion driven by winter and summer varieties, enabling extended availability.
Potato	Stable	High and stable (>10 million MT)	Dominates overall vegetable volumes, serving as a staple with consistent demand, cold storage reliant; 3.8% 5 yr CAGR.
Cauliflower	Moderate growth	Moderate growth (~3.6% 5 yr CAGR)	Primarily a seasonal winter crop, extremely short shelf life (5–7 days), with growth tied to improved cultivation practices.
Green Chili	Stable	Gradual growth (~4.7% 5 yr CAGR)	Widely distributed, with incremental improvements in yield per hectare; rapid quality loss in humid conditions.
Fruits			
Mango	Expanding	Rapid growth (~2.1% 5 yr CAGR)	High-value seasonal fruit, benefiting from orchard expansion and varietal diversification; highest export focus among fruits.
Banana	Stable	Stable production (~2.3% 5 yr CAGR)	Year-round production ensures a steady supply, though vulnerable to disease outbreaks and transport damage.
Papaya	Variable	Variable	Highly sensitive to climatic variations, leading to fluctuations in output; high post-harvest loss (25–40%).
Watermelon	Expanding	Increasing (~4.3% 5 yr CAGR)	Notable expansion in coastal regions, driven by market demand for summer fruits; bulky, heat-sensitive, and limited storability.

Source: Bangladesh Bureau of Statistics (BBS), Department of Agricultural Extension (DAE); compiled data (2021-24).

These trends underscore a sector in transition, where production gains are evident but often undermined by logistical inefficiencies that fail to keep pace with output volumes.

4.2.2. Production Geography and Concentration

Production geography is a critical determinant of agro-logistics demand and performance in the horticulture sector. Spatial concentration of production, combined with short and overlapping harvest windows, creates localized surges in volume that place acute, time-sensitive pressure on aggregation, transport, storage, and wholesale market infrastructure.

Vegetable production in Bangladesh is predominantly concentrated in the northern and western districts, particularly Rajshahi, Rangpur, Bogura, and Jashore, where fertile soils and favorable agro-climatic conditions support intensive cultivation. These regions function as major supply zones for urban markets but face recurring logistics bottlenecks during peak harvest periods due to limited aggregation and transport capacity.

Fruit production exhibits more pronounced spatial concentration. **Mango** cultivation, in particular, is highly clustered, with the top three producing districts accounting for approximately 50% of national output. This high level of concentration results in sharp, seasonal inflows to market markets during a compressed harvest window, significantly amplifying logistics stress and post-harvest loss risks. **Banana** production shows moderate clustering across central and northern districts, while papaya production is more concentrated in a smaller number of districts spanning northern regions and the Hill Tracts.

Potato production displays moderate geographic clustering, distributed across several major hubs rather than a single dominant region. While this dispersal reduces extreme concentration risk, it still generates substantial seasonal demand for cold storage and transport, particularly during the winter harvest. In contrast, **green chili** production is widely dispersed across multiple agro-ecological zones, including char areas, which reduces localized volume spikes but complicates the deployment of standardized logistics and quality control interventions.

Watermelon production is increasingly shifting toward coastal districts such as Patuakhali, Bhola, and Barguna. While this expansion has improved production potential, it has also heightened exposure to climate variability, salinity intrusion, and extended transport distances to major urban markets, increasing logistics costs and spoilage risks.

Table 3: Key Producing Districts and Geographic Concentration

Crop	Top Producing Districts	Concentration Level (Top 3 Districts)	Primary Agro-Ecological Zone
Vegetables			
Tomato	Rajshahi, Dinajpur, Jashore, Bogura, Cumilla (summer)	High: ~28.5% of national output	Northern & Western Regions
Potato	Munshiganj, Bogura, Rangpur, Dinajpur	Moderate: ~25.28% of national output	Central & Northern Regions
Cauliflower	Tangail, Bogura, Jashore, Cumilla, Dhaka	Distributed: Top 5 districts = ~19.5%	Central & Northern Regions
Green Chili	Bogura, Jamalpur, Gaiband-ha, Jashore, Pabna, Sirajganj, Rajbari	Highly Distributed: Top 3 = ~31.92%	Nationwide, particularly Char areas
Fruits			
Mango	Rajshahi, Chapainawabganj, Naogaon, Satkhira, Natore	Very High: ~50% of national output	Northwestern & Southwestern Regions

Mango	Rajshahi, Chapainawabganj, Naogaon, Satkhira, Natore	Very High: ~50% of national output	Northwestern & Southwestern Regions
Banana	Narsingdi, Tangail, Bogura, Jashore, Rajshahi, Kushtia, Mymensingh, Rangpur, Khagrachari	Moderate: Top 3 = ~21.63%	Central & Northern Regions
Papaya	Rajshahi, Pabna, Jashore, Bandarban, Khagrachari	High: Top 3 = ~43.43%	Northern Region & Hill Tracts
Watermelon	Patuakhali, Bhola, Barguna, Khulna (Dakop)	Expanding: Top 3 = ~30%	Southern/Coastal Region

Source: Calculated from BBS (2025)

The observed pattern of geographic concentration, when combined with compressed and overlapping harvest seasons, creates severe, time-bound logistics pressures. These pressures manifest in congestion at aggregation points, delays in transport, limited access to storage, and overcrowding in wholesale markets, factors that directly contribute to elevated post-harvest losses and value erosion across horticultural value chains.

4.2.3. Seasonality and Logistics Pressure

Seasonality significantly intensifies agro-logistics challenges in the horticulture sector, as most selected crops exhibit distinct and often overlapping harvest peaks. These periods generate short-term surges in volume that exceed the capacity of existing aggregation, transport, and market infrastructure.

Winter vegetables, such as tomatoes and cauliflower, peak between December and February, when high volumes and extremely short shelf lives require rapid movement to markets, as no storage options are available. **Potato** also peaks during this period, but unlike other crops, its storability allows year-round market supply, placing exceptional pressure on cold storage infrastructure, nearly 95% of which is dedicated to potato.

Among fruits, **mango** production is highly seasonal, concentrated within an 8–to 10-weeks window (May–July), creating intense pressure on transportation, ripening facilities, and export logistics. **Watermelon** peaks during the summer months, combining bulkiness with limited storability and high heat exposure. In contrast, **banana and papaya** are produced year-round, resulting in more stable supply patterns, though controlled ripening and quality management remain important, particularly for higher-value markets.

Table 4: Harvest Seasons and Peak Logistics Periods

Crop	Primary Harvest Season	Peak Market Period	Key Logistics Implications
Vegetables			
Tomato	Dec-Mar (Winter); Jul-Sep (Summer)	Dec-Feb	High volume pressure; requires immediate distribution; no storage.
Potato	Dec-Mar	Jan-Mar (from field); Year-round (from storage)	Massive cold storage requirement (95% of national capacity dedicated).

Crop	Primary Harvest Season	Peak Market Period	Key Logistics Implications
Cauliflower	Nov-Feb (Winter)	Dec-Jan	Extremely short shelf life (5-7 days); immediate transport essential.
Green Chili	May-Nov (Summer/Monsoon)	Jun-Sep	Monsoon transport challenges; quality degradation in wet conditions.
Fruits			
Mango	May-August	June-Jul	Highly concentrated 6–8-week harvest; export window pressure; requires controlled ripening.
Banana	Year-round	Continuous	Steady supply reduces storage need; benefits from ripening chambers.
Watermelon	Mar-Jun (Summer)	Apr-May	High summer demand; limited storability; bulky transport.
Papaya	Year-round (Peak winter quality)	Continuous (Higher quality Nov-Feb)	Consistent supply; winter harvest preferred for export.

Source: Analysis based on KIIs and sector reports.

So, seasonality in horticulture manifests primarily as acute logistics bottlenecks rather than storage opportunities, leading to market gluts, price volatility, and elevated post-harvest losses. Potato remains the main exception due to its compatibility with cold storage systems.

4.3. Climate Vulnerability Analysis

Bangladesh's horticulture sector is increasingly exposed to climate-related risks, including floods, cyclones, droughts, salinity intrusion, and rising temperatures (Akter et al., 2025). These risks affect crops unevenly and have direct implications for post-harvest handling and agro-logistics performance.

As summarized in Table 4.1.4, most **vegetable crops** show relatively low to moderate climate sensitivity. Tomato and potato face moderate flood and drought risks that can disrupt harvest timing and increase pressure on transport and markets. Green chili is comparatively more vulnerable, with moderate exposure across multiple hazards, particularly during the monsoon season when transport disruptions and humidity-driven quality losses are common.

Fruits are generally more climate-sensitive. Mango production is highly exposed to cyclones and storms, while banana and papaya face high vulnerability to drought and extreme weather, with potential yield losses of 20–40% (Akter et al., 2025). Watermelon, largely grown in coastal and low-lying areas, is especially susceptible to flooding and heat stress. These vulnerabilities amplify logistics challenges by compressing harvest windows, increasing supply volatility, and heightening the need for rapid aggregation and timely transport.

Table 5: Climate Risk Matrix for Selected Horticulture Crops

Crop	Flood Risk	Drought Risk	Cyclone/Storm Risk	Heat Stress	Salinity
Vegetables					
Tomato	Low	Moderate	Moderate	Low	Low
Potato	Moderate	Moderate	Low	Low	Low
Cauliflower	Low	Low	Low	Low	Low
Green Chili	Moderate	Moderate	Moderate	Moderate	Moderate
Fruits					
Mango	Low	Moderate	Moderate	Low	Low
Banana	Moderate	**High (20-40% yield loss)**	**Very High**	Moderate	**High**
Watermelon	**High**	Moderate	Moderate	Moderate	Moderate
Papaya	Moderate	**High (20-40% yield loss)**	**High**	Moderate	Moderate

Source: Synthesized from Akter et al. (2025) and BAMIS (2020).

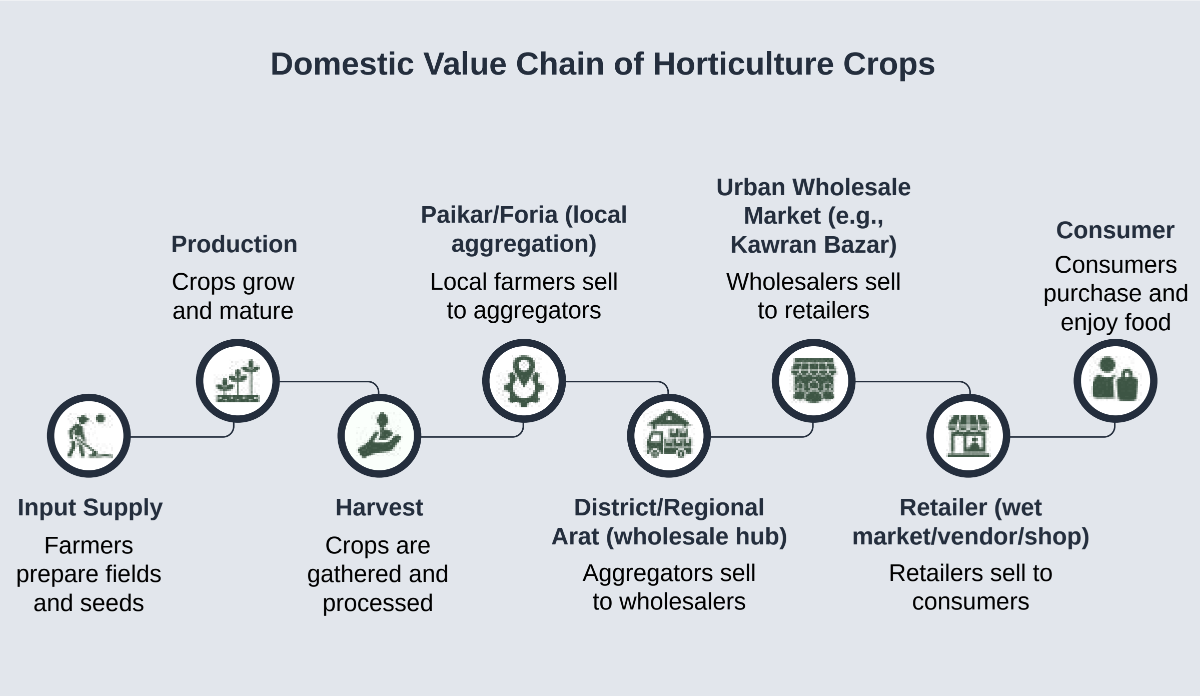
Climate risks interact with existing agro-logistics weaknesses to amplify post-harvest losses. Extreme weather events and increasing variability in rainfall and temperature disrupt harvesting schedules, damage transport infrastructure, and compress marketing windows, thereby intensifying congestion and delays.

4.4 Value Chain of Selected Horticulture Products

The horticulture value chain in Bangladesh is **intermediary-dense, fragmented, and largely informal,** resulting in high transaction costs, repeated handling, and significant value leakage. Most products move through a traditional brokerage system that prioritizes **rapid turnover** over quality preservation. As a result, post-harvest loss and price escalation are structural features of the chain rather than isolated outcomes.

4.4.1 End-to-End Value Chain Mapping

Domestic Value Chain (standard flow for horticulture crops): The generalized domestic flow for vegetables and fruits is:

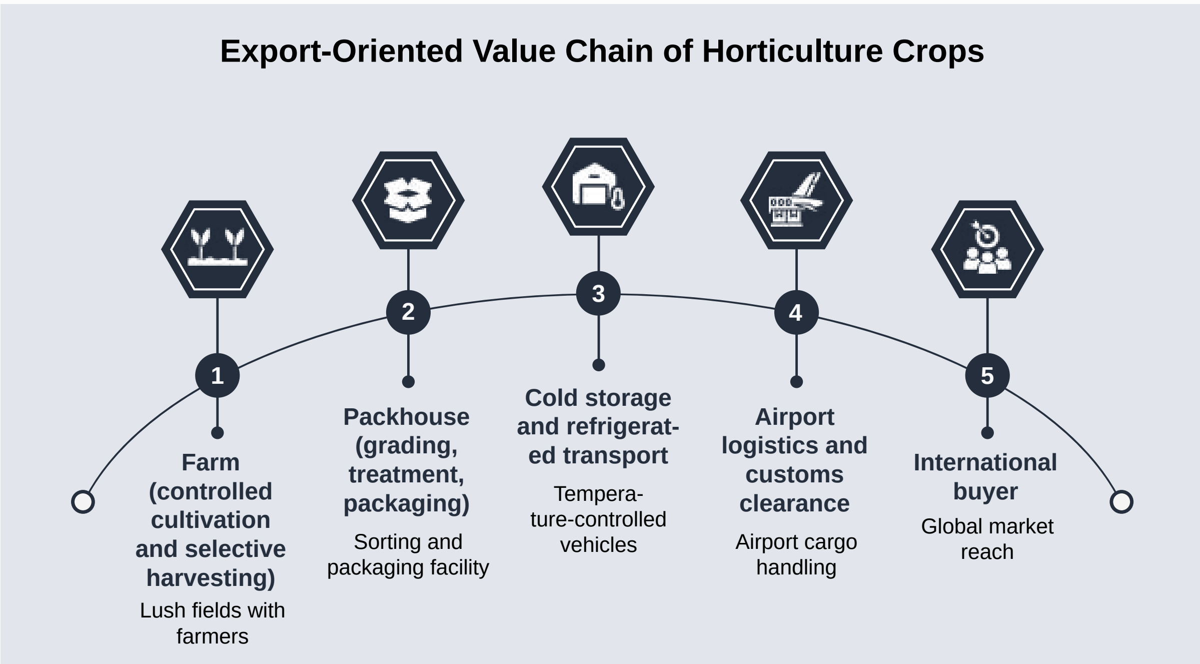


Synthesized from secondary sources (RVO, 2021; Gazi, 2020; Tarannum & Ahona, 2023; and TBS, 2019) and KIIs

This domestic chain is characterized by:

• Multiple handovers (often 4–7 transactions before retail),
• Predominantly open-air handling and ambient storage, and
• Heavy reliance on non-refrigerated transport, which accelerates quality deterioration, especially for short-shelf-life crops such as tomato and cauliflower.

Export-Oriented Value Chain (mango): Export chains are more linear but technically demanding:



Synthesized from secondary sources (RVO, 2021, and Tarannum & Ahona, 2023) and KIIs

Export-oriented chains add critical compliance steps, particularly phytosanitary treatment and traceability, requiring specialized infrastructure and coordination not typically present in domestic chains.

Domestic vs Export Chains: Key Differences

Feature	Domestic Value Chain	Export Value Chain (e.g., mango)
Primary goal	Volume and rapid turnover	Quality, safety, compliance
Quality control	Visual sorting by traders	Certified grading, treatment, and traceability
Storage	Ambient/open-air; minimal buffering	Cold storage and refrigerated movement required
Intermediaries	Multiple traders (paikar–bepari–aratdar)	Fewer actors, often coordinated by exporters/packhouses
Treatment	Minimal (cleaning only)	Phytosanitary treatment (e.g., hot water/vapor heat) + SPS protocols

4.4.2 Market Value and Pricing Trend

Price formation in the horticulture value chain is characterized by significant markups as products progress from farm-gate to retail, driven by factors such as handling inefficiencies, transportation expenses, intermediary commissions, and premiums for assuming spoilage risks. These escalations are particularly pronounced in perishable goods, where time-sensitive logistics play a decisive role.

Pricing in horticulture is highly volatile, influenced by seasonality, supply gluts, transportation costs, and intermediary margins. Farm-gate prices are often a fraction of final retail prices. Major urban wholesale markets like **Kawran Bazar** in Dhaka serve as the primary price-setting nodes, handling **up to 1,000 MT** of vegetables daily with a daily turnover of approximately **BDT50 million** (TBS, 2024; KIIs). Price information asymmetry between farmers in remote areas and traders in urban centers is a significant issue.

The following table provides indicative price structures across the chain, illustrating typical ranges and primary drivers.

Table 6: Indicative Price Structures of Horticulture Crops

Crop	Farm-Gate (BDT/kg)	Wholesale (BDT/kg)	Retail (BDT/kg)	Key Price Driver
Tomato	15–25	30–45	50–70	Seasonal gluts leading to spoilage and distress sales.
Potato	10–15	20–30	35–45	Cold storage release timing, seasonal supply fluctuations.
Cauliflower	12–20	25–40	45–60	Extremely short shelf-life, rapid quality loss.
Green Chili	60–90	100–140	160–220	Variations in quality, pungency, and market preferences.

Crop	Farm-Gate (BDT/kg)	Wholesale (BDT/kg)	Retail (BDT/kg)	Key Price Driver
Mango	40–80	90–150	180–300	Ripening stages, variety premiums, and export demand.
Banana	20–30	40–55	70–100	Transport-induced damage, continuous but vulnerable supply.
Papaya	25–40	50–80	90–140	Losses during ripening and handling.
Watermelon	8–12	15–20	25–35	Bulky transport costs, heat exposure, and seasonal glut.

Indicative ranges based on Department of Agricultural Marketing (DAM), BBS, and Key Informant Interviews (KIIs).

Price volatility is most acute for tomato, mango, and green chili, reflecting the sector's limited capacity to buffer supply shocks. Inadequate storage, insufficient cold chain coverage, and inefficient transport systems constrain the ability of the horticulture value chain to smooth seasonal fluctuations, resulting in sharp price swings and uneven value distribution between producers and consumers.

4.4.3. Actor Ecosystem

Bangladesh's horticulture value chain features a diverse ecosystem of actors, from smallholder farmers to retailers, each handling aggregation, transport, and sales amid challenges like poor infrastructure and quality loss. This fragmented system drives high transaction costs and post-harvest wastage.

Table 7: Actor Ecosystem in the Horticulture Value Chain

Actor Category	Key Players	Primary Functions	Value Chain Impact & Pain Points
Producers	Smallholder farmers (typically 1–3 acres), commercial growers	Cultivation, harvesting, and basic sorting	Determine initial quality; face first-mile losses; low price realization due to weak bargaining power and limited market information
Foria/Paikar	Village-level buyers, mobile traders	Farm-gate purchase, first aggregation, local transport	Provide liquidity and price discovery; increase handling; margins often driven by risk and spoilage exposure
Bepari/Agents	Commission agents, area collectors	Market linkage, arranging transport to larger markets	Facilitate chain connectivity; add commission costs; often increase handling without quality control improvements
Aratdar/ Wholesalers	Market traders, commission agents, warehouse operators	Auctioning/wholesale sales, financing, short-term holding	Key price-setting node; storage is usually ambient with limited buffering capacity; congestion and delays increase losses

Actor Category	Key Players	Primary Functions	Value Chain Impact & Pain Points
Transport Operators	Truck/pick-up owners, local transport services	Product movement between nodes	Dominant logistics enabler; largely non-refrigerated fleet; vibration/heat exposure and delays drive quality loss and shrinkage
Retailers	Wet market vendors, shops, supermarkets	Final sale, display, and small holding	Highest markups; limited capacity for cold storage/handling; quality loss at retail is common due to ambient display
Digital Market Places	Chaldal, Fashol, Tazafol, Khamare	Online Grocery Services	Digital marketplaces offer measurable income improvements for farmers who participate, especially those able to meet quality standards and aggregate volume. However, their overall impact on the farming population and production volume remains limited at present. Scaling up requires infrastructure investments, cooperative organization, financial inclusion, and regulatory support.
Cold Storage Operators	Private cold storage owners (potato-dominant)	Cold storage services	Stabilize potato supply across seasons; limited multi-crop suitability; congestion and power risks affect performance
Processors	Fruit/veg processors (e.g., juice/pulp/drying)	Value addition, preservation	Absorb a small share of output; constrained by inconsistent raw material quality and weak upstream aggregation/logistics
Regulators	DAE, DAM, BSTI, Plant Quarantine, EPB	Standards, market oversight, SPS, and export facilitation	Compliance gaps driven by limited enforcement capacity, lack of accredited labs, and weak coordination across nodes

Source: Synthesized from secondary sources (Hasan, 2024; Islam et al., 2024; RVO, 2021; and Tarannum & Ahona, 2023) and KIIs.

4.4.4 Economic Leakage and Value Erosion

The domestic horticulture chain experiences two linked forms of economic leakage:

• **Post-harvest losses:** Cumulative wastage in domestic chains commonly ranges from 25–35%, driven primarily by weak first-mile handling, poor packaging (e.g., bamboo baskets/sacks), delays at wholesale markets, and the absence of end-to-end cold chain continuity (Hasan, 2024; and RVO, 2021).

• **Price escalation:** Consumer prices are often **200–300% higher than farm-gate prices** (Tarannum & Ahona, 2023; Bonik Barte, 2024). A large share of the price spread is absorbed by intermediary margins, transport costs, and risk premiums associated with spoilage, rather than accruing to producers.

The horticulture value chain is best understood as a time-sensitive logistics system where value is created or lost through handling quality, speed, and preservation capacity. Improving outcomes, therefore, depends less on increasing production and more on strengthening first-mile practices, aggregation efficiency, packaging systems, transport standards, and cold-chain continuity, especially between packhouses/markets and airport nodes for export crops.

4.5. Post-Harvest Loss Analysis of Selected Horticultural Products

4.5.1. Post-Harvest Process of Horticultural Products

Post-harvest handling varies by crop but consistently reveals gaps in technology and standardization. The table below details key components.

Table 8: Climate Risk Matrix for Selected Horticulture Crops

Crop	Harvest Method	Sorting/ Grading	Primary Packaging	Storage	Transport Dominance
Tomato	Hand picked	Minimal, visual	Bamboo baskets / crates	None	Open/covered trucks
Potato	Manual/ mechanical	Size based	Jute/plastic bags	Cold storage (6–9 months)	Open/covered trucks
Cauliflower	Manual cutting	Visual, minimal	Open baskets/plastic and jute bags	None (1–3 days)	Covered trucks
Green Chili	Hand picked	Basic, damaged removal	Mesh/plastic/jute bags	Limited homestead	Covered trucks
Mango	Hand-picked with stem	Multi-grade (export)	Plastic crates / cartons	Limited storage	Mixed
Banana	Bunch cutting	De-handing, washing	Bulk stacking	Hanging / ripening rooms	Open trucks
Papaya	Hand picked	Ripeness based	Individually wrapped	Minimal	Covered trucks
Watermelon	Hand picked	Visual, sound test	Direct loading	None	Open trucks & boats

Source: Hassan et al. (2010); RVO (2022); and KIIs.

Key Packaging Issues: The use of non-standard, reusable containers like bamboo baskets leads to compression damage, poor ventilation, and bruising. A shift to plastic crates for tomatoes has shown promise, reducing transport losses from 25% to 12% (RVO, 2022). According to findings from KIIs and research conducted by BARI, trucks have better weights with jute (14 tons against 12 tons), but plastic crates have some outstanding disparities in terms of maintaining quality and cost.

This overview emphasizes the widespread absence of essential practices like pre-cooling, standardized grading protocols, and widespread cold storage adoption, which collectively contribute to accelerated spoilage.

4.5.2. Reasons for Post-Harvest Loss

Post-harvest losses in the horticulture sector stem from systemic issues across the value chain, particularly first-mile handling, transport deficiencies, and market delays, leading to 20-44% wastage for fruits and vegetables (BSS, 2024; Khatun et al., 2014). While national statistics present overall post-harvest losses, field data from the Bangladesh Agricultural Research Institute (BARI) breaks down the specific sources of these losses along the value chain. In the case of bananas, total annual losses amount to approximately BDT 535 crore, representing 26% of total production. Importantly, interview findings indicate that losses are not concentrated at a single stage but occur at every handover point:

• **Grower Level**: 2.13%
• **Local Assembly**: 2.12%
• **Long-Distance Transport:** 9.0% (the single largest point of loss)
• **Wholesale:** 7.25%
• **Retail & Consumer:** 5.5% (combined)

Furthermore, Hanay Foods noted that even with proper handling, 2–3% of produce may still be damaged by the time it reaches its destination due to heat stress and compression during transportation. This underscores the critical need for refrigerated (reefer) vans, which, however, remain largely unaffordable for most private operators.

• **First-Mile Handling Failures:** Inadequate practices at the farm level, including the absence of pre-cooling or cleaning, harvesting at suboptimal maturity stages, and reliance on rudimentary packaging like sacks and bamboo baskets, initiate early deterioration.

• **Transport-Related Damage:** The predominance of open trucks exposes produces to heat, vibration, and compression during transit. Extended travel times due to road congestion, combined with less than 2% availability of refrigerated vehicles, exacerbate bruising, wilting, and microbial growth (Akter et al, 2025; Rahman, 2023; RVO, 2022).

• **Aggregation and Wholesale Congestion:** Delays ranging from 24–72 hours at collection points and markets, without buffer cold storage, lead to prolonged exposure to ambient conditions. Multiple rehandling cycles further compound physical damage (BSS, 2024; RVO, 2022).

• **Cold Chain Discontinuity:** Even where cooling is applied (e.g., at packhouses), subsequent exposure during market or airport handling causes thermal shocks, condensation, and rapid decay (KII, Rahman, 2023; RVO, 2022).

• **Market-Driven Losses:** Seasonal gluts trigger distress sales and price collapses, resulting in unsold inventory that is discarded. These losses manifest as:
a) Physical Loss: Discarded produce due to spoilage.
b) Quality Loss: Downgrading to lower-value uses.
c) Market/Value Loss: Economic erosion from depressed prices.

These drivers are compounded by geographic concentration, seasonal peaks, and infrastructure gaps. Addressing these requires holistic interventions beyond crop-specific fixes.

4.5.3. Current Infrastructure, Logistics, and Capacity

Storage and Cold Chain

Bangladesh boasts approximately **405 cold storage facilities** with a total capacity of around 6 million metric tons. However, 95% of this infrastructure is dedicated exclusively to potatoes, leaving negligible capacity for multi-crop use relative to overall horticultural production (RVO, 2022).

Bangladesh intends to set up 100 small cold stores that will hold vegetables (2025 announcement), 500 onion houses by FY2025-26, to reduce the losses other than that of potatoes. (The Observer BD, 2025, June 2). These additions focus on multi-commodity facilities in production hubs like Rajshahi, Jashore, and Bogura, aiming for 25 new units through public-private partnerships. Current non-potato horticultural needs exceed this by over 20-fold, given annual production volumes and 20-40% loss rates.

Unreliable power and high costs are genuine challenges; **strategic, region-specific approaches, especially increased solar subsidies and targeted grid improvements**, can enable cold storage expansion in Bangladesh. The solution here is not to wait for nationwide grid transformation, but to sequence investments according to local energy realities and accelerate supportive policies where needed.

While progressive, the scale covers <5% of requirements for fruits/vegetables, insufficient against rising output (5%+ growth) and export demands post-LDC graduation. Full viability requires scaling to 100,000+ MT with subsidized operations and integration into value chains like Kawran Bazar logistics (Lawrence & Khan, 2021; TBS, 2024; World Bank, 2021).

Potato cold storage investments succeeded due to a unique combination of high, predictable volume, storability, government support, and a simple rural investment model. The same conditions do not exist for other crops, and the investor base (dominated by rural landlords and traders) lacks the incentives or capabilities to expand into more complex, higher-risk multi-commodity storage. Deliberate government intervention and new business models are required to support the process.

Transport Infrastructure

Road transport dominates horticultural logistics, accounting for 95% of movements. The fleet is composed as follows (RVO, 2022; Tarannum & Ahona, 2023):

- Covered trucks: 60%
- Open trucks: 30%
- Pickups/vans: 8–10%
- Refrigerated trucks: <2%

The high cost of refrigerated transport (2.5–3.5 times that of ambient options) renders it economically unviable for most domestic markets, limiting its adoption to premium export segments (Lawrence & Khan, 2021; RVO, 2022).

Packhouses and Processing

Fewer than 50 packhouses operate nationwide, with key facilities like the Central Pack House in Shyampur running below capacity due to inconsistent inbound logistics from fragmented farm aggregations (KII, Lawrence & Khan, 2021; RVO, 2022). These packhouses handle grading, packaging, and basic treatments but suffer from poor first-mile supply reliability, limiting throughput for crops like mangoes and vegetables end route to Kawran Bazar or exports.

Processing absorbs only ~12% of production, constrained by variable raw quality and logistics gaps, missing opportunities for juices, pulps, and dried products (RVO, 2022; Tarannum & Ahona, 2023). Underutilization exacerbates 20-40% post-harvest losses, as ambient handling prevails without integrated cooling (Lawrence & Khan, 2021; RVO, 2022; TBS, 2024).

Wholesale and Export Infrastructure

Major wholesale markets in Bangladesh, such as Kawran Bazar, lack essential cooling facilities, proper drainage, and mechanized loading bays, leading to congestion and accelerated spoilage of horticultural produce (RVO, 2022; TBS, 2024). Airports lack dedicated cold zones for perishables, while the scarcity of accredited laboratories for sanitary and phytosanitary (SPS) standards and residue testing hinders compliance with international requirements (KII, Lawrence & Khan, 2021; RVO, 2022; World Bank, 2021). Consequently, export logistics emerge as the paramount constraint for high-value fruits like mango.

Table 9: Estimated Post-Harvest Loss Percentages Across the Chain

Commodity	Farmer Level	Bepari/ Transport	Wholesaler Level	Retailer Level	Total Estimated Loss
Vegetables					
Tomato	~10%	~10.5% (Bepari 6.6% + Transport*)	3.2%	3.8%	**~27.5%**
Potato	7.7%	4.1%	3.2%	2.3%	**~17.3%** (Plus 5.7% in storage)
Cauliflower	6-10%	4-6%	3-5%	4-6%	**~20-30%**
Green Chili	8-12%	5-7%	3-5%	5-8%	**~25-35%**
Fruits					
Mango	12.3%	7.1%	6.2%	6.1%	**~31.7%**
Banana	8.3%	4.9%	3.4%	3.3%	**~19.9%**
Watermelon	3-5%	2-3%	2-3%	3-4%	**~12-18%**
Papaya	8-12%	6-8%	4-6%	6-8%	**~25-40%**

**Source: FAO-FPMU (2021); Bangladesh literature ranges. Transport loss is integrated into the Bepari stage for this synthesis.*

One of the repeated themes of the interviews is that there is a disparity between theoretical capacity and actual throughput caused by market disconnects. Hanay Foods reported the installed capacity of 10 MT/day, but the actual consumption is only 2MT/day (20%). The eventual bottleneck is found not in seasonality, but in price sensitivity and constraints in the delivery system.

The Department of Agricultural Marketing (DAM) reports that Bangladesh has 384 cold storage facilities, with a combined capacity of over 3.27 million tons. However, due to the lack of integration across the supply chain, significant post-harvest losses persist. Potato losses remain at approximately 26%, while general fruit and vegetable losses range between 26% and 43%.

Stakeholders highlighted critical last-mile failures in export logistics. Vegetable and mango exporters reported that although produce is cooled at the packhouse, the approximately two-hour journey to the airport is typically conducted in ambient vans. This is a deliberate strategy to prevent thermal shock and condensation, as the airport cargo village lacks temperature-controlled holding facilities. Exporters prefer maintaining ambient stability during transit rather than risking a break in the cold chain at the final mile.

4.6. International Value Chain Integration and Export Dynamics

4.6.1. Export Routes, Destinations, and Market Positioning

Bangladesh's horticultural exports remain modest relative to domestic production volumes but demonstrate significant growth potential, particularly in diaspora and niche ethnic markets. In fiscal year 2024-25, **vegetable exports** via sea through Chattogram Port reached 58,766 tonnes, marking a 313% increase from the previous year, with potatoes accounting for 38,046 tonnes, cabbage 15,636 tonnes, green chillies 277 tonnes, tomatoes 167 tonnes, and sweet pumpkins 698 tonnes (Chattogram Plant Quarantine Centre, 2025). Primary destinations for vegetable shipments include the **United Arab Emirates (26% of exports), Qatar (19%), and the United Kingdom (17%)**, reflecting strong demand from South Asian diaspora communities and Middle Eastern markets (Volza, 2024).

Mango exports, while representing only 0.1% of the global fresh mango market estimated at 2.1-2.2 million tonnes, have demonstrated resilience with 2,194 tonnes exported in 2025, representing a 66% increase from 1,321 tonnes in 2024, though still below the 3,100 tonnes achieved in 2023 (OECD, 2025; TFNet, 2025). **Bangladesh currently exports mangoes to 38 countries**, with the United Kingdom receiving the largest volume at 686 tonnes, followed by Saudi Arabia (356 tonnes), Italy (264 tonnes), Kuwait (167 tonnes), Qatar (163 tonnes), and China (5 tonnes as a new destination) (Department of Agricultural Extension, 2025). **Of the 72 mango varieties cultivated domestically, only seven to eight are export-grade**, with Amrapali accounting for approximately 80% of shipments, complemented by Himsagar, Langra, BARI-4, and Fajli varieties.

A major milestone in **export diversification has been the introduction of sea-based fruit shipments**. In 2025, for the first time, mangoes and jackfruits were exported by sea to the United Arab

4.6.2. International Logistics Actors and Service Providers

The international horticultural value chain involves multiple specialized actors across freight forwarding, quality assurance, and compliance services. **For air exports**, major international carriers operating from Hazrat Shahjalal International Airport include Emirates Cargo, Qatar Airways Cargo, Singapore Airlines Cargo, and Turkish Cargo, with **freight rates ranging between $3.50-$5.00 per kg depending on destination and season.** These airlines provide critical **temperature-controlled (15-20°C) cargo** holds for perishable shipments, though capacity during peak mango season (May-July) becomes constrained. **Sea-based exports** are facilitated through Chattogram Port, where international shipping lines including Maersk Line, MSC (Mediterranean Shipping Company), CMA CGM, and Evergreen Marine operate reefer container services to Middle Eastern and European destinations. Transit times range from 10-12 days to the Gulf region and 18-25 days to European ports, with reefer **container costs averaging $2,500-3,500 per twenty-foot equivalent unit (TEU) depending on destination.**

Within Bangladesh, export-oriented aggregators and processors include major players such as PRAN-RFL Group (exporting to 145 countries with agro-food products valued at approaching $1 billion annually), ACI Agribusiness, Lal Teer Seed, and multiple smaller exporters represented by the **Bangladesh Fruits, Vegetables and Allied Products Exporters Association (with 303 active members).** These actors coordinate farmer aggregation, packhouse operations, cold storage access, and export documentation.

4.6.3. Critical Public Service Actors in Export Compliance

Export of horticultural products requires mandatory **phytosanitary certification governed by the Plant Quarantine Act 2011 and Plant Quarantine Rules 2018.** The Plant Quarantine Wing (PQW) under the Department of Agricultural Extension, Ministry of Agriculture, serves as the competent authority responsible for issuing phytosanitary certificates that attest to pest-free status and compliance with importing country requirements.

Plant Quarantine Wing (PQW) operates inspection stations at key exit points: Hazrat Shahjalal International Airport (for air cargo), Chattogram Seaport, and Chattogram Airport (Shah Amanat International Airport). Exporters must apply for phytosanitary certificates 24-48 hours in advance, providing details of consignment, destination country, and import permit numbers. Inspection fees are nominal (BDT 500-1,500 depending on consignment size), though processing times can extend to 2-3 days during peak seasons, creating bottlenecks for time-sensitive perishable exports.

The **Bangladesh Food Safety Authority (BFSA) operates complementary testing and certification functions.** BFSA-accredited laboratories, including the Institute of Public Health (IPH) in Dhaka and BFSA regional labs in Chattogram and Khulna, conduct pesticide residue testing to ensure Maximum Residue Limits (MRLs) compliance with EU, US, and Gulf Cooperation Council (GCC) standards. Testing costs range from BDT 10,000-25,000 per sample for multi-residue analysis, with turnaround times of 7-14 days, which discourages small-scale exporters from routine testing.

Receiving country authorities impose additional requirements. **For EU markets**, exporters must comply with European Commission regulations on plant health (EU Regulation 2016/2031) and contaminant limits. UK importers require certification from the Animal and Plant Health Agency (APHA), while **US imports** are subject to Animal and Plant Health Inspection Service (APHIS) regulations. **GCC countries**, particularly Saudi Arabia and the UAE, require halal certification (where applicable), a certificate of origin from the Export Promotion Bureau (EPB), and commercial invoice authentication by respective consular offices.

4.6.4. Informal and Border Trade Dynamics

While formal export statistics dominate policy discourse, **border trade with India** represents a significant, if under-documented, channel for horticultural products. Bangladesh-India border haats (within 5 km of the international border) facilitate localized exchange of vegetables, fruits, and spices. Fresh vegetable trade to India increased 42.04% in FY2024-25, reaching portions of the $1.76 billion total exports to India, with fish and agricultural products benefiting from the South Asian Free Trade Area (SAFTA) framework (Export Promotion Bureau, 2025).

Border trade with Myanmar, while smaller in volume, provides outlets for specific crops. Through the Maungdaw and Sittwe-Teknaf crossings, Bangladesh exports modest quantities of processed vegetables and spices, though imports (onions, ginger, pulses) substantially exceed exports. In FY2019-20, Bangladesh's total export to Myanmar was approximately $30 million, while imports reached $181 million, with agricultural commodities comprising 40% of border trade volumes. Political and security constraints along the Bangladesh-Myanmar border have curtailed personal movement since 2017, though goods flow continues under bilateral border trade agreements established in 1994-1995.

Border trade channels operate within a complex regulatory environment. While **formal border trade points** exist at Benapole-Petrapole (India), Teknaf-Sittwe (Myanmar), and **other designated Land Customs Stations, informal crossings** persist due to limited enforcement capacity, tariff differentials, and inadequate formalization of local agricultural exchanges. Estimates suggest that informal cross-border agricultural trade may be 2-3 times the documented volume, though quantification remains methodologically challenging (CUTS International, 2019).

4.6.5. Investment Projects and Infrastructure Development Initiatives

Several international development partners and private entities are interested in investing in Bangladesh's horticultural export infrastructure, recognizing the sector's potential for foreign exchange earnings and rural income generation.

The United States Department of Agriculture (USDA), through its Bangladesh Trade Facilitation Project (2021-ongoing), has committed $27 million to streamline agricultural export procedures, upgrade laboratory capacity for SPS compliance testing, and enhance warehouse infrastructure. A key component involves support to establish vapour heat treatment (VHT) facilities, required for fruit fly disinfestation to access markets such as China, Japan, and South Korea, where quarantine protocols prohibit untreated fresh fruit imports. **The absence of VHT facilities currently constrains Bangladesh's ability to penetrate high-value Asian markets.**

In October 2024, the **US Trade and Development Agency (USTDA)** awarded a feasibility study grant to Bangladesh-based Bonton Foods Limited to establish a temperature-controlled logistics network for perishable agro-products, with Minnesota-based Land O'Lakes Venture37 conducting the study. This initiative aims **to mobilize private capital for cold chain infrastructure that supports both export and domestic distribution channels.**

The **International Finance Corporation (IFC),** a member of the World Bank Group, committed BDT 54.68 crore (approximately $6.5 million) in 2019 to Cold Chain Bangladesh Limited (a Golden Harvest Agro Industries subsidiary) **to establish multi-temperature cold storage facilities at 12 strategic locations with dedicated reefer trailer fleets for farm-to-port logistics.** This represents Bangladesh's first integrated cold chain service provider model, enabling third-party cold storage and transport services on a commercial basis.

The Asian Development Bank (ADB) has integrated agro-logistics development within its broader Logistics Sector Development program, committing $2.57 billion to Bangladesh in 2025 (up from $1.18 billion in 2024), with components **supporting multimodal transport corridors, digital customs clearance systems, and economic corridor development** that benefits agricultural commodity movement. ADB's cumulative commitments to Bangladesh exceed $42 billion, with active projects totaling $10.8 billion as of December 2025.

Chinese investment in agro-processing zones, particularly the Mongla Export Processing Zone near the Mongla seaport, provides infrastructure conducive to horticultural value addition and export. While specific project-level data on Chinese investments in Bangladesh's agricultural cold chain remains limited in public documentation, broader Belt and Road Initiative (BRI) connectivity projects, including the development of the Payra Seaport and Dhaka-Chittagong rail corridor, indirectly enhance agricultural logistics efficiency.

Japanese development assistance, channeled through the **Japan International Cooperation Agency (JICA),** has historically focused on broader infrastructure (roads, ports, power) rather than sector-specific agricultural cold chain, though JICA-funded improvements to national highways and the Matarbari Deep Sea Port project create enabling conditions for horticultural export logistics.

The Government of Bangladesh, through the **Sustainable and Renewable Energy Development Authority (SREDA),** has piloted solar-powered mini cold storage units (6-8 tonne capacity) with financing from Palli Karma-Sahayak Foundation (PKSF), targeting farmer-level post-harvest handling. While still at demonstration scale, these units represent a modality for off-grid cold storage expansion in remote production areas.

4.7. Strategic Analysis & Way Forward – Horticulture Sub-Sector

4.7.1. Cumulative Loss and Economic Impact

Aggregated losses across the eight priority horticultural commodities indicate a substantial and recurring economic drain. Using midpoint loss estimates (approximately 20–44%, depending on crop) and average market production values, annual financial losses are estimated at **USD 1.3–2.6 billion** (BBS, 2023; Lawrence & Khan, 2021; World Bank, 2021).

This represents a major leakage of farmer income, consumer welfare, and national agricultural value-added. If these losses were reduced by half, Bangladesh could raise effective food availability **by roughly 15%** without expanding cultivated land, highlighting the strong productivity gains achievable through logistics and post-harvest improvements alone (BSS, 2024; TBS, 2024).

4.7.2. SWOT Analysis

A consolidated SWOT perspective for the horticulture sector is summarized below:

Strengths	Weaknesses
• Sustained production growth (often exceeding 5% annually) and strong domestic demand, driven by urbanization and a growing middle class • Presence of premium varieties with established market identity (e.g., Himsagar mango, Bogura chili)	• High post-harvest losses due to weak first-mile handling, poor packaging, and repeated handling across intermediary-heavy chains • Near absence of multi-commodity cold chain infrastructure beyond potato-centric storage systems

Strengths	Weaknesses
• Emerging niche export opportunities, particularly to the Middle East and selected EU markets	• Quality and compliance constraints, including pesticide residue risks and limited testing capacity • Weak hygiene, congestion, and limited infrastructure at local arats and wholesale markets
Opportunities	**Threats**
• Expansion potential in processing and value addition (current processing absorption ~12%) to reduce glut-driven losses and stabilize prices • Expansion potential in processing and value addition (current processing absorption ~12%) to reduce glut-driven losses and stabilize prices • Digitalization and emerging logistics-enabled business models (e-commerce, digital traceability tools) that can shorten chains and improve coordination	• Rising climate risks (erratic rainfall, heat stress, salinity intrusion in southern regions) that increase supply volatility and post-harvest risk • Increasing pest pressure (e.g., fruit fly incidence in mango) and related quality downgrade risks • Trade risks from non-tariff barriers and potential erosion of preferential market access following LDC graduation in 2026

4.7.3. Investment and Policy Implications

Transforming Bangladesh's horticulture sector from a fragmented, loss-prone system into a competitive and resilient value chain requires **integrated investments and policy actions** focused on first-mile handling, logistics efficiency, cold chain continuity, market infrastructure, and export compliance. The analysis indicates that the highest returns will come from interventions that reduce cumulative post-harvest losses rather than expanding production.

Strategic Priorities

Priority actions are outlined below and summarized in the table.

• **Multi-Commodity Infrastructure Development (PPP Priority):** Public–private partnerships should be prioritized to develop **integrated packhouses and multi-commodity cold storage** in major production clusters such as Rajshahi, Jashore, and Bogura. These facilities should combine grading, treatment, packaging, and cold storage functions to support both domestic and export markets. While the government's plan to establish 25 multi-crop facilities is a positive step, current and planned capacity remains insufficient relative to non-potato horticultural volumes, underscoring the need for private sector participation and scalable PPP models.

• **Wholesale Market Modernization and Terminal Market Development:** Strategic wholesale hubs, including Kawran Bazar, Bogura, and Jashore, should be upgraded toward **modern terminal market functions.** Priority upgrades include improved sanitation and drainage, standardized weighing systems, dedicated unloading and loading bays, and the introduction of **pre-cooling or buffer cold zones.** These measures are critical to reducing congestion-related delays and heat-stress deterioration during peak arrival periods.

• **Logistics Efficiency and Standardized Packaging:** Reducing handling damage and transport-related losses requires a systematic shift from bamboo baskets and sacks to **Returnable Plastic Crates (RPCs)** through leasing, cooperative pooling, or targeted subsidy mechanisms. Complementary policy incentives are needed to stimulate private investment in insulated and refrigerated transport, particularly along high-volume corridors linking production clusters to urban markets.

The development of **nano-emulsions and edible coatings,** such as aloe vera gel and chitosan, offers a promising approach to extending the shelf life of fruits like **papaya and guava** without relying on refrigeration. In particular, aloe vera gel, used alone or in combination with other organic compounds, has demonstrated significant potential as a food-safe and environmentally friendly coating. It helps maintain the quality of fruits and vegetables over extended periods and contributes to reducing post-harvest losses across the supply chain.

• **Strengthening the First Mile:** Scaling extension services focused on **Good Agricultural Practices (GAP), maturity indexing, and harvest-at-right-stage protocols** are essential to improving initial product quality. These efforts should be coupled with practical handling improvements, including crate use, shaded aggregation points, and pilot deployment of mobile or decentralized pre-cooling units in high-loss clusters to rapidly remove field heat and extend shelf life.

• **Enabling Value Addition and Processing Linkages:** Fiscal and financial incentives, such as tax relief and concessional credit, should be introduced to expand horticultural processing capacity and strengthen structured procurement from farmer groups. Increasing processing absorption from approximately **12% to 25%** would reduce glut-driven price collapses, improve utilization of surplus production, and create more stable demand outlets.

• **Export Competitiveness and SPS Readiness:** Improving export performance requires targeted investment in accredited laboratory capacity for pesticide residue and SPS testing, alongside streamlined packhouse-to-airport logistics. Establishing end-to-end cold chain continuity, including temperature-controlled airport cargo handling, will reduce quality loss at critical nodes and improve compliance with international MRL requirements for fruits and vegetables.

• **Climate Resilience Embedded in Agro-Logistics Planning:** Climate risks should be mainstreamed into cluster-level planning by promoting heat- and salt-resilient varieties in vulnerable zones and expanding protective cultivation (e.g., net houses, plastic tunnels) for high-value crops. Climate-resilient logistics investments should also include improved drainage at aggregation points and contingency transport planning during extreme weather events.

• **Inclusive Mechanization for Agro-Processing SMEs:** According to the Bangladesh Agricultural Research Institute (BARI), the sustainable development of agricultural Small and Medium Enterprises (SMEs) depends more on introducing **low-cost, locally adaptable machinery** than on prioritizing large-scale infrastructure. Imported, large-scale equipment is often economically inaccessible to small farmers, service providers, and processors.

By focusing on the **design and promotion of affordable washers, dryers, and graders,** BARI aims to address the 25–40% post-harvest losses in horticultural crops while simultaneously **strengthening local light-engineering hubs such as Bogura and Jessore.** This strategic shift toward inclusive mechanization would enhance the resilience of the agro-processing sector and enable small-scale entrepreneurs to compete effectively in both domestic and export markets.

Table 10: Summary of Priority Interventions and Delivery Framework

Priority Area	Key Actions	Primary Responsibility	Delivery Model
1. First-Mile Loss Reduction (Highest ROI)	• Scale GAP and maturity-indexed harvesting • Introduce plastic crate pooling systems • Pilot mobile/decentralized pre-cooling in high-loss clusters	DAE, DAM, Private aggregators	Public-led with private service provision
2. Multi-Commodity Packhouses & Cold Storage	• Establish integrated packhouses with grading, treatment, and cold rooms in clusters (Rajshahi, Jashore, Bogura) • Expand beyond potato-centric cold storage	MoA, LGED, PPP Authority	PPP (public infrastructure + private operation & management)
3. Wholesale Market Modernization	• Upgrade Kawran Bazar and regional hubs to terminal markets • Add sanitation, drainage, unloading bays, and buffer cold zones	City Corporations, LGED	Public investment with private concessions
4. Transport & Packaging Efficiency	• Promote returnable plastic crates (RPCs) via leasing/subsidy • Incentivize insulated and refrigerated transport fleets on key corridors Development of edible coatings (aloe vera gel, chitosan)	MoA, MoT, Private logistics firms	Market-led with policy incentives
5. Processing & Value Addition Expansion	• Fiscal incentives (tax relief, concessional finance) • Strengthen processor–farmer linkages for glut absorption	MoF, Banks, Private processors	Private sector–driven
6. Export Logistics & SPS Readiness	• Establish accredited pesticide residue/SPS labs • Ensure end-to-end cold chain from packhouse to airport cargo	DAE, Plant Quarantine Wing, CAAB	Public investment + private operations
7. Climate-Resilient Agro-Logistics	• Promote heat- and salt-tolerant varieties • Expand protective cultivation (net houses, tunnels) • Climate-proof aggregation points	DAE, BARI, LGED	Public support + farmer/private adoption

Cross-Cutting Enablers

• **Digitalization:** Traceability apps, market information systems, and logistics coordination platforms
• **Institutional Coordination:** Stronger alignment among DAE, DAM, BSTI, Plant Quarantine, and City Corporations
• **Finance:** Blended finance and risk-sharing instruments to crowd in private logistics investment

Expected Outcomes

• **25–50% reduction** in post-harvest losses for priority crops
• **Higher farm-gate price realization** and reduced price volatility
• **Improved food availability** equivalent to ~15% output gain without land expansion
• **Enhanced export compliance and reliability,** particularly for fruits and fresh vegetables.

05

System Mapping – Fisheries Sub-Sector

5.1. Sector Overview and Relevance of Selected Fishery Products

The fisheries sector is a cornerstone of Bangladesh's economy, food security, and rural livelihoods, characterized by heavy dependence on small-scale producers and predominantly informal production and marketing systems. Bangladesh has emerged as the world's fifth-largest aquaculture producer and the third-largest inland fish producer, reflecting sustained growth in pond-based aquaculture alongside inland capture fisheries (DoF, 2024). The sector supports the livelihoods of approximately 20 million people and makes a substantial macroeconomic contribution, accounting for 2.5% of national GDP and 22.26% of agricultural GDP (DoF, 2024). Fish remains the country's primary source of animal protein, underscoring the sector's central role in nutrition and food security.

Structurally, the sector is split between aquaculture and capture fisheries, with aquaculture now accounting for approximately 57% of total fish production, while capture fisheries, both inland and marine, contribute the remaining share. Aquaculture growth has been driven by smallholder pond systems producing freshwater finfish, while capture fisheries remain critical for livelihoods in riverine and coastal regions. Within this dual structure, hilsa (Ilish) occupies a unique position as a wild-capture fishery of exceptional cultural, economic, and symbolic importance, distinct from farmed species in both production dynamics and logistics requirements.

This analysis focuses on four key fisheries commodity groups that together capture the diversity of production systems, market orientation, and agro-logistics challenges in Bangladesh:

- **Shrimp (Bagda/Galda):** The principal export commodity, supported by a relatively advanced processing and cold chain system, yet constrained by disease risks, shrimp fry/PL shortages, Lower productivity-thus high cost of production than competing countries, and significant first-mile inefficiencies.

- **Major Carps (Rui, Catla, Mrigal):** The backbone of domestic aquaculture and freshwater fish consumption, produced largely by smallholders and characterized by high volumes but minimal post-harvest preservation.

- **Pangasius and Tilapia:** Rapidly expanding cultured finfish supplying urban and peri-urban markets, reliant on fresh and live-fish distribution systems that are highly time- and temperature-sensitive.

- **Hilsa (Ilish):** A culturally iconic wild-capture fishery with high unit value and premium consumer demand, marked by strong seasonality, geographic concentration, and biologically driven conservation measures.

Hilsa merits particular attention because its economic losses are disproportionately high relative to volume. As a premium fish, even modest quality deterioration translates into substantial value erosion, making post-harvest inefficiencies especially costly in monetary terms. Its dependence on wild stocks, long fishing trips, and congestion at landing and wholesale markets further amplifies logistics stress compared to farmed species.

The fisheries sector operates through distinct but unevenly developed value chains. **Shrimp** has the most formalized chain due to stringent export and food safety requirements, supported by 77 EU-approved HACCP-compliant processing plants (DoF, 2024). However, even within this comparatively advanced chain, significant inefficiencies persist, including 20–30-hour delays between farm harvest and processing, during which quality degradation and irreversible losses occur.

In contrast, the value chains for **major carps, pangasius, and tilapia** are overwhelmingly oriented toward domestic fresh markets and rely almost entirely on ice-based preservation and non-refrigerated transport, with minimal integration of cold chain infrastructure. **Hilsa,** as a seasonal wild-capture fishery, faces additionalcomplexity due to conservation-driven management measures, including a 22-day brood hilsa ban and a 60-day jatka ban, which create sharp and predictable annual supply fluctuations (BFRI, 2023).

Together, these structural features, small-scale production dominance, limited formalization, divergent aquaculture and capture systems, and uneven logistics development, translate into uneven post-harvest loss patterns, pronounced price volatility, and recurring logistics bottlenecks. As such, fisheries provide a compelling case for examining how agro-logistics constraints, rather than production limitations, shape economic outcomes, value distribution, and food system efficiency in Bangladesh.

5.2. Production Trend, Geography, Concentration, and Seasonality

5.2.1. Production Trends

Total fish production has shown steady growth, increasing from **4.76 million MT in 2021-22 to over 5.02 million MT in 2023-24** (DoF, 2024). Major carps dominate production volumes, while shrimp and hilsa are high-value segments. The selected fishery products display distinct production dynamics, influenced by advancements in aquaculture techniques, market demands, and environmental

Table 11: National Production Trends for Key Commodities (Metric Tons)

Commodity	2021-22 (MT)	2022-23 (MT)	2023-24 (MT)	Strategic Observations
Total Fish Production	4,758,731	4,914,715	5,018,483	Exceeded the government target of 4.89M MT.
Major Carps	1,013,812	1,084,397	1,136,095	Primary driver of domestic food security.
Tilapia	407,359	421,191	439,678	High growth due to monosex culture tech.
Pangasius	406,185	403,283	418,629	Recovering after feed price shocks.
Shrimp/Prawn	261,154	271,302	260,486	Impacted by viral attacks and heat stress.
Hilsa	566,593	571,342	529,487	Declined due to ecological traps and siltation.

Source: Department of Fisheries Yearbook 2023-24, compiled from recent analyses.

These trends illustrate aquaculture's pivotal role in offsetting stagnation in capture fisheries, with commercially viable species like Pangasius and Tilapia experiencing accelerated adoption through semi-intensive and intensive methods.

5.2.3 Production Geography and Concentration

Fish production in Bangladesh is spatially concentrated across distinct regional clusters, creating localized production efficiencies but also exposing the fisheries sector to systemic logistics, climate, and market vulnerabilities. The degree of geographic concentration varies significantly by commodity, with direct implications for aggregation patterns, transport distances, cold chain demand, exposure to climate shocks, and price volatility.

As shown in the table, **major carps,** despite accounting for the largest share of national fish production, are relatively geographically dispersed. The top-producing districts, Jashore, Rajshahi, and Cumilla, together account for only 12.55% of national output, reflecting the widespread distribution of smallholder pond-based aquaculture across the country. While this dispersion reduces the risk of localized supply shocks, it complicates the deployment of standardized logistics services, coordinated cold chain investments, and structured market interventions.

In contrast, **hilsa production is extremely concentrated,** with coastal and estuarine districts, particularly Bhola, Barguna, and Patuakhali, accounting for 57.83% of total landings. More critically, hilsa spawning is concentrated within a relatively narrow ecological zone of the **Meghna–Padma delta,** making the fishery highly sensitive to habitat degradation, river flow changes, and climate variability. This spatial concentration, combined with strong seasonality and conservation-driven fishing bans, results in sharp and predictable supply surges that routinely overwhelm landing centers, ice plants, transport corridors, and wholesale markets during peak fishing periods.

Pangasius and shrimp/prawn also exhibit high levels of geographic concentration, though driven by different structural factors. Nearly 47.36% of pangasius production is clustered in Mymensingh, Cumilla, and Jashore, with Mymensingh emerging as the dominant hub due to the prevalence of intensive pond culture, feed supply networks, and trader linkages. This clustering supports economies of scale but heightens vulnerability to flooding, disease outbreaks, and transport disruptions, which can rapidly affect national supply.

Similarly, 43.41% of shrimp and prawn output originates from Bagerhat, Satkhira, and Khulna, reflecting the concentration of coastal gher systems and processing infrastructure in the southwest. At the upstream end, shrimp production is further constrained by extreme hatchery concentration, with approximately **95% of shrimp hatcheries located in Cox's Bazar,** creating systemic risk related to disease transmission, seed supply disruptions, and long-distance post-larval transport.

Tilapia production shows a moderate level of concentration, with 22.31% of output coming from Cumilla, Mymensingh, and Jashore. This balance between clustering and dispersion has supported relatively stable year-round supply, but localized harvest peaks still generate logistics pressure in production hubs, particularly for live-fish transport.

Table 12: Production Geography and Concentration of Key Fisheries Commodities

Commodity	Top Production Districts	Strategic Observations
Major Carps	Jashore, Rajshahi, Cumilla	12.55% (dispersed production)
Hilsa	Bhola, Barguna, Patuakhali	57.83% (highly concentrated)
Tilapia	Cumilla, Mymensingh, Jashore	22.31% (moderately concentrated)
Pangasius	Mymensingh, Cumilla, Jashore	47.36% (highly concentrated)
Shrimp/Prawn	Bagerhat, Satkhira, Khulna	43.41% (highly concentrated)

Source: Synthesized from Department of Fisheries (DoF) 2024 and Yearbook of Fisheries Statistics 2023-24.

These concentration patterns intensify logistics pressure during peak harvests and heighten exposure to localized climate, disease, and market risks.

5.2.4 Seasonality and Logistics Pressure

Seasonality is a key driver of logistics stress in the fisheries sector, as harvest peaks often coincide with weather-related disruptions and limited preservation capacity. These temporal dynamics result in sudden volume surges, localized ice shortages, congestion at landing centers, and pressure on transport corridors, particularly for highly perishable fresh fish.

As shown in the table below, **Hilsa** exhibits the most pronounced seasonality, with a major harvest peak during June-October and a minor season in February-March. These short and intense fishing windows generate abrupt inflows of fish that overwhelm landing centers, ice plants, transport services, and wholesale markets. The resulting congestion and delays significantly elevate post-harvest losses and quality deterioration.

The following is the concentration of the shrimp and prawn harvesting periods, marine shrimp (Bagda) peaks are March to July and the freshwater prawn (Golda) is between October to February and much overlaps with the monsoon season. These harvesting periods coincide with the monsoon season and have increased logistics risks including transport delays and the reliance of cold chain to ensure quality of exports.

In contrast, **major carps, pangasius, and tilapia** are produced **year-round**, providing a more stable supply profile. However, this continuity creates sustained demand for ice, cold storage, and transport services. Pangasius faces additional pressure from bulk handling and periodic oversupply, which can trigger price volatility and losses. Tilapia, often traded live, is particularly sensitive to transport timing and oxygen management; even short delays can result in mortality and rapid loss of value.

Table 13: Seasonality and Logistics Implications by Product

Product	Peak Harvest Season	Key Logistics Implications
Hilsa	June–Oct (main), Feb–Mar (minor)	Sudden surges; severe congestion at landing centers and transport routes
Shrimp	May-Aug marine shrimp, October-Feb freshwater prawn	Export quality risks during monsoon; high icing and cold chain demand
Major carps	Year-round (winter peak)	Continuous need for ice and preservation amid steady supply
Pangasius	Year-round	Bulk handling pressure; oversupply-driven volatility
Tilapia	Year-round	Critical live transport timing to maintain premium value

5.3. Climate Vulnerability Analysis

The fisheries sector is increasingly exposed to floods, cyclones, salinity intrusion, temperature stress, and climate-induced disease outbreaks. Climate risks vary significantly by species, culture system, and production geography, with direct implications for production stability and post-harvest logistics.

Table 14: Climate, Disease, and Salinity Risk Matrix by Commodity

Risk Factor	Shrimp	Major Carps	Pangasius / Tilapia	Hilsa
WSSV (White Spot Syndrome Virus)	Very High	Not applicable	Not applicable	Not applicable
EUS (Ulcerative Syndrome)	Low	High (18–33%)	Moderate	Low

Risk Factor	Shrimp	Major Carps	Pangasius / Tilapia	Hilsa
Cyclone Damage	Very High	Moderate	Moderate	High
Flooding	High	High	High	Moderate
Salinity Intrusion	High (Galda affected)	Very High	Very High	Low
Overfishing Pressure	Not applicable	Not applicable	Not applicable	High

Source: Synthesized from reports and papers of WorldFish (2024); Kabir et al. (2023); Mozumder et al. (2023); FAO (2022); Habib et al. (2022); Lauria et al. (2018); Islam (2015)

Production Zone Vulnerability

• **Southwest Coastal Belt (Khulna, Satkhira, Bagerhat):** Produces over 75% of national crustacean output and faces very high vulnerability due to cyclones, storm surges, and progressive salinization. Shrimp farming in this zone is highly exposed to White Spot Syndrome Virus (WSSV), which can cause up to 100% mortality within 3–10 days of outbreak (Hasan et al., 2020; Haque et al., 2020).

• **Central Floodplains (Mymensingh, Jashore):** Core production zone for major carps and pangasius. Seasonal flooding increases the spread of Epizootic Ulcerative Syndrome (EUS) and creates management challenges, though overall vulnerability remains moderate with proper flood control.

• **Haor and Wetland Systems (Northeast):** Subject to flash floods and water-level volatility; while risky for traditional pond culture, these areas offer scope for climate-resilient tilapia cage culture.

• **Meghna–Padma Delta and Coastal Rivers:** Although hilsa catches are geographically dispersed, spawning is concentrated within a limited deltaic area, making the fishery highly sensitive to habitat degradation and hydrological changes.

Species-Specific Climate Sensitivity and Adaptation Potential

• **Shrimp:** High-value but high-risk; extremely sensitive to cyclones, salinity shifts, and disease.

• **Major Carps:** Vulnerable to disrupted breeding cycles and flooding; reliance on hatchery-produced seed (≈99%) necessitates climate-adjusted broodstock and hatchery management.

• **Pangasius and Tilapia:** More tolerant of intensive systems; tilapia in particular is the most climate-resilient species, capable of withstanding temperature fluctuations and poorer water quality.

• **Hilsa:** A wild-capture fishery dependent on healthy estuarine ecosystems; long-term sustainability requires habitat protection and coordinated fishing bans, including cross-border management with India.

Seasonal Climate–Logistics Pressure Points

• **February–March:** Peak shrimp fry collection; initiation of hatchery cycles for carps and tilapia.

• **May–August:** Monsoon breeding season; peak flood risk; hilsa migration and fishing bans.

• **September–October:** Peak hilsa landings and 22-day brood ban; completion of shrimp harvest.

• **November–January:** Major harvest period for carps and pangasius; peak demand for icing, transport, and wholesale handling.

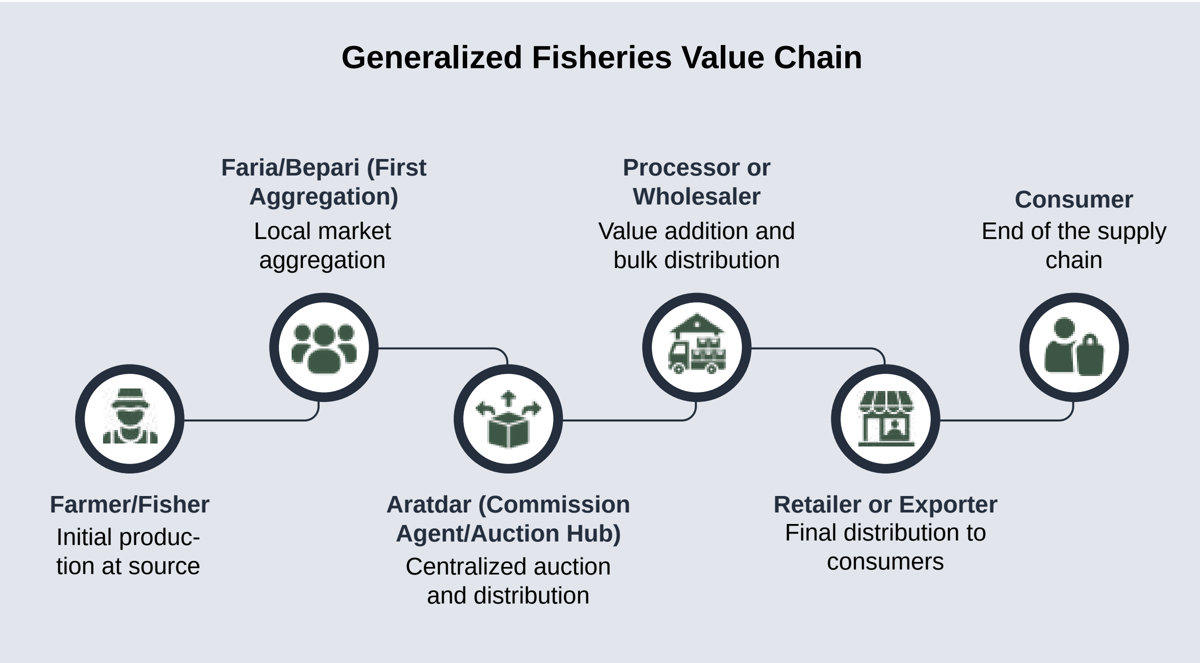
5.4. Value Chain Structure of Selected Fishery Products

Bangladesh's fisheries value chains are commodity-specific, intermediary-driven, and unevenly developed, reflecting differences in production systems (aquaculture vs. wild capture), market orientation (export vs. domestic), and regulatory intensity. While all products move through multiple intermediaries, the depth of formality, logistics sophistication, and quality control varies sharply across shrimp, major carps, pangasius/tilapia, and hilsa.

At a systemic level, the sector prioritizes **speed and turnover over preservation,** particularly in domestic fresh-fish markets. This structure reduces immediate spoilage risk but results in cumulative quality deterioration, price volatility, and value erosion, especially where cold chain integration is weak.

5.4.1 End-to-End Value Chain Mapping for Fishery Products

Across commodities, the generalized fisheries value chain follows this sequence:



However, each commodity follows a distinct end-to-end architecture depending on origin, handling requirements, and market destination.

End-to-End Value Chain Architecture by Commodity

Stage	Shrimp	Major Carps	Pangasius / Tilapia	Hilsa
Origin	Hatchery / wild PL	Hatchery	Hatchery	Wild capture
Production	Coastal ghers (Khulna, Satkhira)	Freshwater ponds nationwide	Intensive ponds (Mymensingh, Jashore)	Rivers and estuaries
1st Aggregation	Faria collectors / local Aratdar	Faria collectors	Farm-gate sales to Bepari	Landing ghats (Chandpur, Bhola)

Stage	Shrimp	Major Carps	Pangasius / Tilapia	Hilsa
Depot / Sorting	Shrimp depots (Khulna, Satkhira)	Wholesale markets (e.g., Kawran Bazar)	Direct to whole-sale markets	Boro Station (Chandpur), Barishal markets
Processing	HACCP plants (≈ 100 licensed; 77 EU-approved)	Minimal (sold fresh)	Limited filleting/-freezing	Minimal
Wholesale	Dhaka/Chattogram (domestic); processors (export)	Kawran Bazar, Showarighat (Dhaka)	Kawran Bazar, regional markets	Kawran Bazar, Jatrabari (Dhaka)
Retail / Export	EU, USA, Japan, Middle East	Domestic wet markets	Domestic wet markets	Domestic wet markets; limited export to India

Source: Synthesized from Kabir et al. (2023); Shafiuddin (2021); Muzareba & Khondkar (2019); Islam et al. (2013); FAO (2012); Islam et al. (2006)

This mapping highlights the clear structural divide between export-oriented shrimp chains and domestic finfish and hilsa chains, which remain largely ice-dependent and informal.

Domestic vs. Export Chains: Key Differences

Feature	Domestic Fish Chains (Carps, Pangasius, Tilapia, Hilsa)	Export Chain (Shrimp)
Primary objective	Rapid turnover and freshness	Quality, safety, and compliance
Cold chain	Ice-based; limited mechanical refrigeration	Integrated freezing and cold storage
Processing	Minimal or absent	HACCP-certified processing mandatory
Intermediaries	Multiple (Faria–Bepari–Aratdar)	Fewer, processor-led coordination
Quality control	Visual inspection only	SPS testing, traceability, and audits
Market risk	High price volatility	Exposure to global demand and compliance costs

Shrimp exports benefit from formalized infrastructure and regulatory oversight, but still suffer from upstream inefficiencies such as delayed icing and disease risk. Domestic chains, while more flexible, experience higher cumulative losses and weaker value retention due to poor logistics and market congestion.

5.4.2 Seed Systems and Upstream Vulnerabilities

Upstream input systems, particularly **seed and post-larvae (PL) supply,** represent a critical but often underappreciated source of loss and risk in Bangladesh’s fisheries value chains. These vulnerabilities are most pronounced in aquaculture-based commodities and have downstream implications for productivity, disease prevalence, and processing capacity utilization.

In the **shrimp sector,** upstream risks are especially acute. Post-larval (PL) mortality during transport and handling is estimated at

28–30%, and can reach up to 50% in some cases, even before stocking at the farm level. Despite the sector's reliance on hatchery seed, **only three hatcheries** currently produce SPF (Specific Pathogen Free) PL, leaving the majority of farms exposed to disease risks, particularly White Spot Syndrome Virus (WSSV) (Haque et al., 2020). The problem is compounded by smuggling and informal PL movement, which weakens biosecurity, traceability, and regulatory oversight, and contributes to recurrent disease outbreaks that undermine farm output and processor utilization.

For **major carps and pangasius/tilapia,** production is almost entirely hatchery-dependent, with an estimated 99% of seed sourced from hatcheries (Ali et al., 2023). While this has enabled rapid aquaculture expansion, it also creates systemic vulnerability to broodstock quality, hatchery management practices, and climate-induced disruptions to breeding cycles (RVO, 2021). Any breakdown in seed quality or supply can quickly cascade through the value chain, affecting national production volumes and market stability (Hasan & Islam, 2019).

In contrast, **hilsa** does not rely on hatchery seed, as it remains a wild-capture fishery. However, its upstream vulnerability lies in the concentration of spawning grounds in the Meghna–Padma delta and heavy dependence on natural recruitment, making the fishery highly sensitive to habitat degradation, overfishing, and hydrological changes (Hossain et al., 2014).

Overall, weaknesses in seed systems and upstream input management, particularly for shrimp and freshwater aquaculture species, constitute a **structural bottleneck** that limits productivity, exacerbates disease risk, and amplifies downstream post-harvest and economic losses.

5.4.3. Market Value and Pricing Trend

The fisheries sector exhibits pronounced disparities in market value and price formation across commodities, driven by differences in market orientation, perishability, and logistics capacity. **Shrimp** dominates export value, although the industry has experienced a significant decline, from a peak of approximately USD 550 million to around USD 300 million in FY 2023–24 (EPB, 2024; BFFEA, 2023). The **European Union** remains the primary destination, absorbing **75–85%** of total shrimp exports. Despite its export orientation, the shrimp value chain remains vulnerable to quality degradation, compliance costs, and lower productivity.

In **domestic fisheries,** price formation is highly fragmented and opaque. The widespread **dadon system (informal advance credit)** binds fishers and farmers to specific traders, effectively locking them into predetermined prices and sharply limiting bargaining power and access to competitive markets. As a result, farm-gate and landing prices often fail to reflect prevailing market conditions.

Prices for domestic species, particularly **major carps,** pangasius, tilapia, and hilsa, are highly volatile, shaped by daily landings, seasonality, weather conditions, and inefficiencies in icing, transport, and storage. Limited buffering capacity through cold storage or live-holding facilities amplifies both price swings and quality loss.

Across all commodities, prices escalate sharply along the value chain due to perishability, spoilage risk, icing and transport costs, multiple intermediary margins, and quality-based price differentiation. These markups are most pronounced in informal domestic chains, where weak logistics and repeated handling increase risk premiums.

Table 15: Indicative Price Structure Across the Fisheries Value Chain (BDT/kg)

Product	Farm/Landing	Wholesale	Retail	Key Price Driver
Hilsa	600–1,200	1,200–1,800	1,800–3,000+	Extreme seasonality, size, and freshness
Shrimp	500–900	900–1,400	1,000–1,500+	Export demand, quality grading, and compliance
Major carps	180–280	280–380	400–550	Freshness, steady domestic demand
Pangasius	130–180	200–260	280–350	Bulk supply, oversupply risk
Tilapia	150–220	220–300	320–420	Live-fish premium, urban demand

Indicative ranges based on recent market observations; hilsa prices can spike sharply during festivals and peak seasons.

Price volatility is most acute for **hilsa,** due to strong seasonality and conservation-related supply shocks, and for **shrimp,** due to exposure to international market dynamics. These patterns underscore the absence of effective buffering mechanisms, particularly cold storage, live-holding, and coordinated market release, which remain critical constraints to stabilizing prices and reducing value erosion in the fisheries sector.

5.4.4. Actor Ecosystem in Fisheries Value Chain

Across shrimp, hilsa, major carps, and pangasius/tilapia value chains, a broadly similar set of actors is involved, but their **roles, power, and influence differ substantially by commodity and market orientation.** The fisheries sector remains heavily intermediary-driven, with limited formal contracting and weak traceability outside export-oriented shrimp.

Core actors include:

- **Seed suppliers and hatcheries** for aquaculture species; wild-capture fishers for hilsa
- **Smallholder farmers and fishers,** operating at small scale with limited bargaining power
- **Aggregators (Faria, Bepari)** who consolidate volumes and provide liquidity, often linked to informal dadon credit
- **Commission agents (Aratdar)** who dominate auctions, price discovery, and market access
- **Transporters,** largely using non-refrigerated vehicles and ice-based preservation
- **Processors,** significant mainly in shrimp export chains
- **Regulators,** led by the Department of Fisheries (DoF) and export-focused SPS authorities

The **dadon system** plays a central role in shaping actor power dynamics. It is strongest in **hilsa and shrimp** value chains, where fishers and farmers are heavily dependent on advance financing from aratdars, depot owners, or traders, effectively locking them into predetermined sales channels and suppressing farm- or landing-site prices. In **major carps and pangasius/tilapia,** dadon linkages are moderate, particularly for smallholders, while larger commercial farms retain slightly greater flexibility in buyer choice.

Table 16: Indicative Price Structure Across the Fisheries Value Chain (BDT/kg)

Actor Category	Shrimp (Export-Oriented)	Hilsa (Wild Capture)	Major Carps (Domestic)	Pangasius & Tilapia (Domestic)
Producers	Coastal gher farmers; dependent on hatcheries and depots	Small-scale riverine/coastal fishers	Pond-based smallholders nationwide	Commercial pond farmers (more intensive)

Actor Category	Shrimp (Export-Oriented)	Hilsa (Wild Capture)	Major Carps (Domestic)	Pangasius & Tilapia (Domestic)
Seed / Origin Control	High (hatchery PL critical)	Not applicable (wild stock)	High (hatchery seed dominant)	High (hatchery seed dominant)
First Aggregators	Faria + depot owners (strong control)	Landing ghat intermediaries	Faria collectors	Bepari often purchase directly
Commission Agents (Aratdar)	Moderate influence (export price increasingly driven by processors)	Very high influence, especially during peak seasons	High influence in wholesale markets	High influence in urban wholesale markets
Processors	Dominant actors (HACCP plants set quality standards and exert pricing power)	Minimal role	Minimal role	Limited (some filleting/-freezing)
Transporters	Semi-controlled; linked to depots/processors	Highly fragmented; congestion-prone	Fragmented, ice-based	Fragmented; time-sensitive (live fish)
Regulatory Oversight	Strong (SPS, HACCP, export compliance)	Weak (focused mainly on fishing bans)	Weak	Weak
Traceability & Quality Control	Partial traceability enforced	Absent	Absent	Absent
Producer Bargaining Power	Low–moderate	Very low	Low	Low–moderate (for larger farms)

Source: Synthesized from Kabir et al. (2023); Islam et al. (2013); Alam et al. (2012); FAO (2012); Islam et al. (2006); and KII findings

The **shrimp value chain is processor- and compliance-driven,** with export processors exercising substantial pricing power and setting quality standards, even though upstream segments remain vulnerable to disease, delayed icing, and raw material shortages. In contrast, **hilsa and domestic finfish chains are dominated by intermediaries,** with aratdars and aggregators exerting disproportionate influence over prices and market access, an influence reinforced by dadon credit relationships. The continued absence of formal contracts, integrated cold chains, and traceability in domestic chains remains a central structural constraint to reducing post-harvest losses and improving value distribution for major carps, pangasius, tilapia, and hilsa.

5.4.5. Economic Leakage and Value Erosion

Across fisheries value chains, economic leakage occurs through four interlinked mechanisms:

• **Dadon (Informal Credit) System:** Ties producers to specific buyers, suppresses farm-gate prices, and restricts access to competitive markets.

• **High Post-Harvest Losses:** Driven by delayed icing, inadequate ice-to-fish ratios, poor packaging, repeated handling, and temperature abuse, particularly acute for hilsa and shrimp.

- **Fragmented and Non-Refrigerated Transport:** Reliance on open trucks, buses, and boats increases spoilage risk during long-distance and overnight transport.

- **Weak Traceability and Quality Assurance:** Outside shrimp exports, the absence of traceability undermines food safety, price differentiation, and export potential for finfish.

Cumulative post-harvest losses across fisheries are estimated at **20–25%**, translating into **annual economic losses exceeding USD 150 million** (FAO, 2024; Hossain et al., 2024), with hilsa and shrimp accounting for the highest per-ton value erosion.

5.5. Post-Harvest Loss Analysis of Selected Fishery Products

5.5.1. Post-Harvest Process of Fishery Products

Post-harvest handling in Bangladesh's fisheries sector remains largely traditional, ice-dependent, and weakly standardized, with critical failures concentrated at the **first mile** and during **midstream transport and market handling.** These weaknesses lead to substantial **physical loss, quality degradation, and value erosion** across shrimp, hilsa, major carps, and pangasius/tilapia value chains. Despite differences in market orientation and infrastructure, early-stage temperature control and protected handling remain the most decisive factors shaping post-harvest outcomes.

Table 17: Post-Harvest Handling Components by Product

Product	Harvest / Landing	Sorting / Grading	Preservation & Cooling	Storage	Transport & Market Interface
Hilsa (wild capture)	Landed at river/coastal ghats; high congestion during peak landings	Primarily size-based grading	Ice use often constrained; first-mile failure includes lack of onboard ice	Minimal cold storage beyond short holding	Rapid movement to urban markets; ambient exposure during transport and auction delays elevates losses
Shrimp	Pond harvest; quality declines rapidly if harvest-to-depot/plant is delayed	Grading at depots and processing plants	Ice-based chilling; first-mile delays (20–30 hours) reported as a major loss driver	Processor cold storage and freezing are the main buffering mechanisms	Mixed transport: ice and limited reefers; downstream cold storage reduces wholesale loss
Major carps	Pond harvest; repeated handling through intermediaries	Minimal grading	Ice is the primary preservation method; no structured first-mile cold chain	Very limited, mostly short holding	Auction delays and ambient-temperature transport common
Pangasius & Tilapia	Pond harvest; bulk volumes (pangasius) and time-sensitive trade (tilapia)	Minimal; tilapia often sorted by size	Ice-dependent; first-mile absence of cold chain is a high-risk point	Very limited; short holding only	High exposure to auction delays and ambient transport; retail losses occur under weak temperature control

Source: Synthesized from Alam et al. (2012); FAO (2012); Islam et al. (2013); Islam et al. (2006); and KII findings

Product-Specific Handling Stress Points

While preservation weaknesses are systemic, **each product faces distinct post-harvest stress points** that intensify losses and value erosion:

• **Hilsa (Ilish):** Hilsa is subject to the **most severe first-mile stress.** Fishing trips often last 8**–12 days,** during which icing is frequently inadequate or delayed. Quality deterioration begins at sea and is compounded by **repeated re-icing,** congestion at landing ghats, and prolonged auctions. Given hilsa's oily flesh and premium value, even short temperature abuse results in disproportionately high economic losses (Haque et al., 2024; Mandal et al., 2024).

• **Tilapia:** Tilapia increasingly benefits from **live-fish marketing,** which can command a **20–30% price premium** in urban markets. However, live transport is technically weak, relying on informal oxygenation and overcrowded containers. Mortality and stress during transport frequently offset the price premium, making tilapia highly sensitive to handling quality and transit time.

• **Shrimp:** Although shrimp benefits from relatively advanced downstream processing and cold storage, **upstream quality damage** is often irreversible. Delays of **20–30 hours** between pond harvest and processing allow enzymatic degradation and bacterial growth that cannot be corrected through freezing or grading. As a result, even modern HACCP-compliant plants cannot fully recover value lost at the first mile (Kabir et al., 2023).

5.5.2 Reasons for Post-Harvest Loss of Fishery Products

Post-harvest losses are not limited to visible spoilage. While physical losses remain significant, a larger share of economic damage occurs through quality degradation and value erosion, particularly in premium and highly perishable products. Understanding losses, therefore, requires distinguishing between physical loss and value loss, and then tracing how both accumulate across stages of the value chain.

Physical Loss vs. Value Loss

Post-harvest loss in fisheries manifests in two distinct but interrelated forms:

• **Physical loss**, measured as discarded or unmarketable biomass (kg per MT), and
• **Value loss**, measured as quality downgrade (kg per MT sold at discounted prices).

Across most fishery products, value loss significantly exceeds visible physical spoilage. While a portion of fish is physically lost through mortality, spoilage, or breakage, a much larger share suffers quality deterioration due to temperature abuse, delayed icing, and repeated handling. This downgraded fish often remains saleable but at sharply reduced prices, resulting in disproportionate economic loss.

For example:

• **Hilsa** experiences relatively modest physical loss at landing, but extensive quality downgrade due to long fishing trips, repeated re-icing, and auction delays, translating into the **highest per-MT economic loss** in the sector (Haque et al., 2024; Mandal et al., 2024).

• **Shrimp** may reach processors with limited visible spoilage, yet upstream enzymatic and bacterial degradation caused by delayed icing reduces export grade, yields, and processor margins, losses that are not reversible through freezing.

• **Carps, pangasius, and tilapia** often retain physical integrity but suffer loss of freshness, texture, and appearance, leading to price discounts rather than outright rejection.

This distinction underscores that post-harvest loss is primarily an economic and logistics problem, not merely a waste management issue.

Stage-wise Loss Drivers

Post-harvest losses accumulate across the chain, with distinct loss drivers at each stage. While all stages contribute, losses are most acute at the **first mile and aggregation/auction points.**

i. Harvest and Landing Losses

• **Shrimp:** Significant losses occur even before grow-out, with **PL mortality of 28–30%,** reducing effective production and increasing downstream cost pressure (Kabir et al., 2023).

• **Hilsa:** Measurable physical loss of **5.29% occurs at landing,** before the fish enters wholesale distribution, reflecting stress during long fishing trips and inadequate onboard icing (Haque et al., 2024; Mandal et al., 2024).

ii. First-Mile Losses (Largest Systemic Bottleneck)

• **Hilsa:** Lack of ice on boats and delayed icing immediately after catch leads to rapid spoilage in the most critical freshness window.

• **Major carps and pangasius/tilapia:** Absence of a structured first-mile cold chain makes farm-to-depot movement a consistently high-risk stage.

• **Shrimp:** Loss risk is amplified by **20–30-hour delays** between pond harvest and arrival at depots or processing plants (Kabir et al., 2023).

iii. Depot, Aggregation, and Auction Losses

• Repeated handling and congestion at aggregation points increase physical damage and temperature abuse.

• At **Kawran Bazar**, fish arrivals peak at night, with **auction delays of 2–4 hours,** during which fish are often held on open floors at ambient temperatures (Acharjee et al., 2025; Ray et al., 2015).

• These delays alone contribute to **5–12% quality loss,** particularly for hilsa and freshwater finfish.

iv. Midstream Transport Losses

• Domestic finfish chains rely largely on a**mbient transport (≈25–35°C)** with partial ice cooling.

• Iced transport typically maintains temperatures around 4–10°C, but inconsistent ice-to-fish ratios undermine effectiveness (Acharjee et al., 2025; Ray et al., 2015).

• Shrimp performs better where processor-linked reefers are used, though such transport is limited to export-oriented flows.

v. Wholesale and Retail Losses

• Wholesale markets lack cold rooms and hygienic holding platforms, leading to extended exposure and accelerated quality decline.

• Retail losses are driven by weak holding conditions, delayed sales, and **freeze–thaw cycles** for finfish.

• Shrimp shows comparatively lower wholesale loss where processor cold storage is available.

Post-harvest losses in fisheries are cumulative and front-loaded, with the **first mile and aggregation stages** accounting for the largest share of both physical and value loss. While downstream cold storage can reduce visible spoilage, it cannot recover value lost upstream. Effective loss reduction, therefore, depends on **early-stage interventions,** immediate icing, protected handling, reduced auction delays, and temperature-controlled transport, rather than downstream fixes alone.

5.6. Current Infrastructure, Logistics, and Capacity

Post-harvest infrastructure in the fisheries sector remains **highly uneven, fragmented, and commodity-biased,** with meaningful investments concentrated almost exclusively in the export-oriented shrimp value chain. In contrast, domestic finfish and hilsa chains depend largely on ice, rapid turnover, and informal logistics, leaving little capacity to absorb quality shocks, seasonal surges, or transport delays. This misalignment between infrastructure availability and loss hotspots is a central driver of post-harvest losses and value erosion.

Cold Chain Gaps

Cold chain penetration in fisheries remains extremely limited outside shrimp exports.

• **Less than 5%** of domestic finfish volumes (major carps, pangasius, tilapia, hilsa) move through any form of mechanical cold chain (DoF, 2024). Preservation relies almost entirely on ice, with no temperature buffering beyond short holding periods.

• Ice plants are widespread and form the backbone of preservation, but their distribution is uneven, and availability in remote rural, riverine, and coastal landing areas is often constrained during peak seasons.

• This **quality of ice preservation inputs** is one of the major limitations, 26%-48% of the ice blocks in some parts were reported to be in untampered states or partially frozen, and also 16%-32% of the ice blocks were reported to be contaminated with debris or iron, which are direct stimulators of the spoilage process.

• Functional pre-cooling, cold storage, or chilling facilities at first-mile nodes, such as landing centers, farms, and ghats, are virtually absent for domestic fish and hilsa.

• Cold storage and freezing infrastructure are concentrated almost entirely within export-oriented shrimp processing plants, leaving domestic chains structurally exposed to spoilage and quality degradation.

The absence of an integrated domestic cold chain represents a major investment gap and opportunity, estimated at **approximately USD 440 million,** particularly for first-mile cooling, wholesale market cold rooms, and insulated transport systems (Mordor Intelligence, 2025).

Transport Infrastructure and Logistics

Transport logistics are dominated by road-based, non-refrigerated movement, with limited modal diversification or temperature control.

Table 18: Indicative Modal Split for Fish Transport

Mode of Transport	Shrimp	Major Carps	Pangasius/Tilapia	Hilsa
Road – non-refrigerated	~60%	~80%	~85%	~70%
Road – insulated	~10%	<5%	<5%	<5%
Road – refrigerated (reefer)	~5%	<1%	<1%	<1%
River/boat	~15%	~10%	~5%	~20%
Live transport	~10%	~25%	~10%	N/A

Source: Synthesized from Data Bridge Market Research (2025); Haque et al. (2024); Tran et al. (2023); Hasan & Nath (2020); Ray et al. (2015)

Key constraints include:

• Predominant use of ambient or partially iced transport, with inconsistent ice-to-fish ratios and limited insulation.

• Refrigerated and insulated vehicles are rare outside export shrimp corridors.

• Live fish transport systems (aerated tanks, oxygen control) remain informal and technically weak, increasing mortality risk despite price premiums.

• Major corridors, such as Barishal–Dhaka, Chandpur–Dhaka, and Khulna–Dhaka, suffer chronic congestion, ferry delays, and poor last-mile connectivity, extending transit times and accelerating spoilage.

Transport inefficiencies disproportionately affect **hilsa and domestic finfish,** where even short delays translate into rapid quality loss and price discounts.

Processing and Export Infrastructure

Unlike competing countries, Bangladesh lacks a developed byproduct utilization ecosystem, which reduces overall value recovery and undermines export competitiveness. The Bangladesh Tilapia Foundation has highlighted **structural weaknesses in the processing segment** of the fisheries economy. Tilapia processors obtain only about a 45% fillet yield, leaving approximately 55% as byproducts (skin, frame, and viscera).
Processing capacity in fisheries is **highly skewed toward shrimp,** reflecting export market requirements.

• Shrimp processing plants are equipped with grading lines, blast freezing, IQF systems, cold storage, and export certification facilities.

• However, despite large installed capacity, utilization remains low (around 10–20%), driven by raw material shortages, disease outbreaks, and irreversible upstream quality losses (Roy, 2025; Light Castle Partners, 2022).

• Processing for domestic fish remains minimal:
a) **Major carps and hilsa** are sold almost entirely as fresh, whole fish.
b) **Pangasius and tilapia** have limited filleting or freezing capacity.
c) **By-product utilization** (low-grade fish, offal, trimmings) is poorly developed.

Export logistics remain vulnerable at ports and airports, where temperature-controlled handling, rapid clearance, and cold storage capacity are often insufficient, posing risks for high-value seafood shipments.

Wholesale Market Congestion and Market Infrastructure

Wholesale and retail markets are critical nodes of loss and value erosion.

• Large urban wholesale markets, such as Kawran Bazar in Dhaka, handle **150–200 MT** of fish per day, with similar pressures in other regional hubs.

• Fish typically arrive at night, and auctions are conducted on open floors, often with **2–4-hour delay**s before clearance.

• During these delays, fish are exposed to ambient temperatures, undermining icing effectiveness and accelerating quality degradation.

Key infrastructure gaps include:

• Absence of cold rooms, pre-cooling zones, or insulated holding areas

• Poor drainage, sanitation, and waste management

• Lack of covered unloading, sorting, and auction platforms

The **hilsa trade** is particularly vulnerable in these markets due to its high value, oily flesh, and rapid spoilage under ambient conditions. Congestion-driven delays during peak seasons amplify both physical and value losses.

Current infrastructure and logistics investments are misaligned with where losses occur. While shrimp exports benefit from relatively advanced downstream facilities, the first mile, domestic cold chain, transport systems, and wholesale markets remain severely underdeveloped. This structural imbalance results in high cumulative losses, especially for hilsa and domestic finfish, where improvements in early-stage cooling, transport insulation, and market-level cold buffering would yield the greatest returns.

5.7. International Value Chain Integration and Export Performance

5.7.1. Export Composition, Volumes, and Destination Markets

Bangladesh's fisheries exports constitute a critical source of foreign exchange earnings and represent one of the country's most mature agro-export sectors. In fiscal year 2024-25, frozen fish and shrimp exports reached $388.7 million, marking a 19.33% increase from $325.73 million the previous year, reversing two consecutive years of decline (Export Promotion Bureau, 2025). This recovery was driven **by improved quality control, enhanced compliance with sanitary standards, and strong demand from India and China.**

Frozen shrimp dominates fisheries exports, accounting for $296.29 million (76% of total fisheries export value) from 23,238 tonnes, representing a 19.32% value increase and 21.5% volume increase compared to FY2023-24, though average export prices dipped slightly from $12.98 to $12.75 per kilogram due to competitive pressure from Vietnam and India (Bangladesh Frozen Food Exporters Association, 2025). Black Tiger shrimp (Penaeus monodon) traditionally dominated exports, but Vannamei shrimp (Litopenaeus vannamei), introduced commercially in 2022, is rapidly gaining market share due to significantly higher yields—8,000-10,000 kg per hectare compared to 1,000 kg per hectare for Bagda (Black Tiger) farming.

Frozen fish exports complemented shrimp, generating $92.41 million from 7,951 tonnes, a 19.38% value increase despite a 10.7% volume decline, as average prices jumped from $8.69 to $11.62 per kilogram, suggesting a strategic shift toward higher-value species or premium market positioning (Export Promotion Bureau, 2025). Bangladesh's national fish, **Hilsa,** comprises a significant portion of frozen fish exports, particularly to India, where approximately 71.4% of Bangladesh's chilled finfish exports are destined, with Hilsa being the only refrigerated finfish species permitted for export to India under bilateral agreements.

China emerged as the largest shrimp importer, purchasing $56.69 million worth in FY2024-25, followed by the Netherlands ($47.39 million), United Kingdom ($44.96 million), Belgium ($40.1 million), Germany ($29.6 million), United States ($20.8 million), France

($18.5 million), Japan ($11.3 million), and Portugal ($8 million). **European markets collectively account for more than half of Bangladesh's frozen shrimp earnings,** reflecting strong demand for sustainable seafood certified to EU standards. For frozen fish, India led imports with $62.54 million, followed by China ($59.03 million) and the UK ($52.87 million), with Bangladesh exporting to 51 countries in total.

Bangladesh's global market share in frozen shrimp exports remains modest, **approximately 1.4% of the $21.3 billion global trade in frozen shrimp and prawns** as of 2023 (Observatory of Economic Complexity, 2023), indicating substantial room for growth, constrained primarily by production capacity, quality compliance, and logistics infrastructure rather than market access limitations.

A notable development has been the first on-board block frozen Ocean Tiger shrimp shipment to Europe in October 2025, with Rancon Sea Fishing Ltd exporting 8.5 tonnes (valued at $167,000) to Belgium, demonstrating Bangladesh's emerging capacity for **deep-sea fishing and at-sea processing,** which commands premium pricing due to superior freshness retention compared to land-based processing.

5.7.2. International Logistics Infrastructure and Service Actors

Frozen seafood exports operate through a specialized logistics chain requiring unbroken cold storage from processing plants to destination ports. The primary export route is via **Chattogram Port,** which handles over 90% of Bangladesh's containerized seafood exports. **Mongla Port** provides secondary capacity, primarily for southwestern coastal region processors in Khulna, Bagerhat, and Satkhira districts.

Major international shipping lines operating reefer container services from Bangladesh include Maersk Line, MSC (Mediterranean Shipping Company), CMA CGM, Hapag-Lloyd, and Evergreen Marine, offering both 20-foot and 40-foot high-cube reefer containers with precise temperature control (-18°C to -25°C for frozen products). Transit times to major markets are: Europe (Rotterdam, Antwerp, Felixstowe) 18-25 days, Middle East (Jeddah, Dubai, Dammam) 10-14 days, North America (East Coast ports) 28-35 days, and East Asia (Shanghai, Hong Kong) 12-18 days. Reefer container costs range from $3,500-5,500 per 40-foot container, depending on destination, season, and global freight market conditions.

Air cargo, while representing less than 5% of export volumes, serves premium fresh fish and high-value live crab/lobster shipments. Emirates SkyCargo, Qatar Airways Cargo, Singapore Airlines Cargo, and Cathay Pacific Cargo provide cold chain-certified services from Hazrat Shahjalal International Airport, with rates ranging from $4.50 to $7.00 per kg depending on destination and product type.

Within Bangladesh, the processing sector comprises approximately 200 member companies of the **Bangladesh Frozen Foods Exporters Association (BFFEA),** though only about 25% (roughly 50 companies) are currently operational, with 75% having suspended activities due to raw material shortages, high operational costs, and financial constraints. Leading processors include Aman Sea Foods, M/S Sonargoan International (which has achieved Good Agricultural Practices certification), MU Sea Food Limited, and Rancon Sea Fishing Ltd. These companies operate EU-approved, HACCP-certified processing plants with combined daily processing capacity estimated at 150-200 tonnes.

5.7.3. Sanitary and Phytosanitary Compliance Architecture

The Department of Fisheries (DoF), Ministry of Fisheries and Livestock, serves as the competent authority for aquaculture and fisheries product certification. The **Fish Inspection and Quality Control (FIQC)** section within DoF conducts establishment approvals, monitors HACCP implementation, and issues health certificates required for export. Bangladesh currently maintains approximately 90 EU-approved establishments (processing plants, freezers, cold storages), each subject to annual inspections and periodic EU audits.

Laboratory testing is conducted through the Fish Inspection and Quality Control Laboratory in Khulna (the primary seafood testing facility) and BFSA-accredited laboratories in Dhaka and Chattogram. **Testing protocols cover:** microbiological analysis (Total Viable Count, E. coli, Salmonella, Vibrio), chemical contaminants (heavy metals including mercury, lead, cadmium), antibiotic residues (nitrofurans, chloramphenicol, tetracyclines), and histamine levels for scombroid fish species. **Full testing panels cost BDT 15,000-30,000 per sample with 5–10-day turnaround times.**

Seafood exports face stringent international standards, particularly for EU, US, and Japanese markets, requiring multi-layered certification and traceability systems. Traceability requirements, particularly stringent for EU markets under EU Regulation 178/2002 and specific fisheries regulations, mandate farm-to-export documentation trails. This includes: hatchery certification (source of post-larvae), farm registration details, feed composition records, water quality monitoring logs, harvest records, processing batch numbers, and storage temperature logs. Chinese importers increasingly require similar traceability, while GCC markets emphasize halal certification from recognized Islamic certification bodies.

Certification bodies providing third-party audits include Bureau Veritas, SGS, TÜV SÜD, and Intertek, which conduct HACCP, BAP (Best Aquaculture Practices), and organic certification audits for processors targeting premium markets. Certification costs range from $5,000-15,000 annually, depending on facility size and certification scope.

The **Bangladesh Marine Fisheries Association** represents industrial fishing vessels and advocates for government support, including the 8% export incentive (set to reduce to 5% in January 2026 and fully withdrawn by November 2026 following LDC graduation), highlighting industry concerns about post-graduation competitiveness.

5.7.4. Import Dynamics and Trade Balance

While Bangladesh is a net exporter of shrimp, it imports substantial quantities of fish to meet domestic demand for specific species and price points. In 2024, the Department of Fisheries authorized the import of over 16,000 tonnes of frozen and dried fish in the first two months alone, with approximately 100,000 tonnes permitted annually (Department of Fisheries, 2024). Imports serve several purposes: fulfilling demand from foreign nationals residing in Bangladesh, meeting market demand for low-priced species unavailable domestically, and providing raw material for certain value-added processing.

Major import sources include Myanmar (dried fish, low-value marine species), India (various freshwater and marine fish), China (tilapia, pangasius), and Thailand (processed seafood products). The value of fish imports reached approximately $50-60 million annually, creating a positive trade balance exceeding $320 million in fisheries products.

Border trade with Myanmar through Maungdaw and Sittwe-Teknaf crossings facilitates the exchange of freshwater fish (Rohingya/Rohu being a major Myanmar export to Bangladesh) and marine products, with marine products, ginger, and onions constituting the primary Myanmar exports. In 2025, 180 tonnes of onions worth $79,950 were exported from Myanmar to Bangladesh in September, rising to 1,175 tonnes worth $696,600 in October, demonstrating the volatility and opportunistic nature of border agricultural trade.

5.7.5. Investment Projects and Development Initiatives

Several international projects target the fisheries sector enhancement, focusing on sustainable aquaculture practices, value chain upgrading, and market access improvement. The **World Bank, through IFC Infraventure** (an infrastructure-focused initiative within IFC), invested in Cold Chain Bangladesh Limited's integrated cold storage network, directly benefiting frozen fish and seafood storage and transport alongside other perishable agricultural commodities.

The **United States Agency for International Development (USAID)** and USDA have supported Bangladesh's fisheries sector through the Feed the Future Bangladesh Integrated Pest Management Activity, which partners with private sector exporters to implement Good Agricultural Practices (GAP) in aquaculture. This includes technical assistance on disease management (particularly Early Mortality Syndrome affecting shrimp), water quality management, feed optimization, and traceability system implementation. Virginia Tech's IPM Innovation Lab, in collaboration with Bangladeshi exporters, including M/S Sonargoan International, has facilitated GAP certification, a critical prerequisite for accessing regulated international markets.

The **Bangladesh Fisheries Research Institute (BFRI), with support from government allocations and international research partnerships,** has led trials on Vannamei shrimp cultivation since 2021, with commercial authorization granted to 12 companies in 2022. BFRI research stations in Paikgacha (Khulna) conduct hatchery development research, broodstock improvement programs, and disease surveillance, with technical cooperation from Thailand's Department of Fisheries and the Network of Aquaculture Centres in Asia-Pacific (NACA).

The **European Union, through its EuropeAid programs,** has provided technical assistance on compliance with EU seafood import regulations, supporting laboratory accreditation, processor training, and documentation systems. While specific current project values are not publicly disclosed, historical EU support to Bangladesh's fisheries sector has exceeded €15 million over the past decade. The **Asian Development Bank's** broader logistics development programs indirectly benefit fisheries exports through improved port infrastructure, customs automation (reducing clearance times for temperature-sensitive shipments), and cold

5.8. Strategic Analysis & Way Forward – Fisheries Sub-Sector

5.8.1. Cumulative Loss and Economic Impact

Post-harvest losses in Bangladesh's fisheries sector indeed represent a systemic economic drain, driven by both physical losses (discarded biomass) and, more importantly, value erosion through quality degradation and price discounting. Across shrimp, hilsa, major carps, and pangasius/tilapia, cumulative losses are estimated at **20–25% of total production,** translating into **annual economic losses exceeding USD 150 million.** High-value species, **hilsa and shrimp,** account for a disproportionate share of economic loss due to their premium prices and sensitivity to temperature abuse. Estimated total loss per metric ton ranges from **USD 330–500 for hilsa and USD 330–480 for shrimp,** compared with **USD 120–240 per MT** for cultured freshwater finfish (Haque et al., 2024; Mandal et al, 2024).

Crucially, most losses originate before products reach processors or wholesale markets, indicating that downstream investments alone cannot recover value already lost at the first mile. Halving first-mile and midstream losses could significantly increase effective fish availability and farmer income without expanding production or fishing effort, while easing pressure on natural stocks.

5.8.2. SWOT Analysis

A consolidated SWOT perspective for the fishery sector is summarized below:

Strengths	Weaknesses
• Bangladesh is the world's 5th-largest aquaculture producer and 3rd-largest inland fish producer, with strong production growth driven by pond-based aquaculture. • Fisheries support ~20 million livelihoods and supply the country's primary source of animal protein. • Shrimp exports benefit from an established base of HACCP-compliant, EU-approved processing plants. • Bangladesh accounts for 75–85% of global hilsa supply, providing a strong comparative advantage.	• High post-harvest losses (20–25%), concentrated at the first mile and during market handling. • Severe cold chain gaps for domestic finfish (<5% penetration). • Heavy dependence on informal intermediaries and the dadon credit system, suppressing producer prices. • Disease vulnerability (WSSV, EUS) and weak seed quality control. • Fragmented, non-refrigerated transport and congested wholesale markets.
Opportunities	**Threats**
• High-return investments in first-mile icing, insulated transport, and live fish systems. • USD 440 million cold chain investment potential for domestic fish. • Shrimp sector recovery through seed system reform and SPF hatchery expansion. • Scope for value-added processing, by-product utilization, and digital traceability. • Regional export opportunities in South and Southeast Asia.	• Increasing climate risks (cyclones, flooding, salinity intrusion). • Persistent disease outbreaks in shrimp and freshwater aquaculture. • Overfishing and habitat degradation are affecting hilsa stocks. • Stricter SPS enforcement and loss of LDC trade preferences post-2026. • Rising feed and input costs.

5.8.3. Investment and Policy Implications

Transforming fisheries into a more efficient, resilient, and value-retentive sector requires prioritizing interventions by economic return, not just loss percentages. Evidence indicates that early-stage, low-cost interventions yield the highest returns by preventing irreversible quality damage.

Strategic Priorities

Priority actions are outlined below and summarized in the table.

• **Modernize Cold Chain Infrastructure (Foundational Priority):** Investments should focus on strategically placed, fit-for-purpose cold chain components rather than capital-intensive end-to-end refrigeration. Priority actions include:

- Expanding ice plants at landing sites and farming clusters, particularly in hilsa and domestic finfish zones
- Promoting insulated containers and boxes for first-mile and midstream handling
- Establishing cold rooms and insulated holding zones at wholesale markets to buffer auction delays

For high-value products, this represents a gradual shift from purely ice-based systems toward mechanized chilling, targeted where economic returns are highest.

• **Disease Management and Quality Seed Systems (High Upstream ROI):** Upstream biological risks remain a binding constraint, especially in shrimp and freshwater aquaculture.

- Expand Specific Pathogen Free (SPF) shrimp hatchery capacity and strengthen regulation of informal PL movement
- Improve seed transport and certification systems to reduce mortality and disease transmission
- Support breeding programs for climate-resilient tilapia strains and improved carp varieties, aligned with rising temperature and salinity risks

These measures directly reduce pre-production and early-stage losses while stabilizing processor utilization and export supply.

• **Market System Reform and Digitalization:** Structural market inefficiencies amplify post-harvest losses and suppress producer prices.

- Introduce digital traceability and market information systems to improve transparency and food safety oversight
- Develop formal credit and working capital mechanisms for fishers and farmers to reduce dependence on the exploitative dadon system
- Encourage platform-based aggregation and transparent auctions to rebalance bargaining power

Market reform is essential to convert physical loss reduction into sustained income gains.

• **Sustainable Fishery Management and Resource Protection:** Long-term logistics efficiency depends on ecological sustainability.

- Strengthen enforcement of hilsa fishing bans and seasonal closures
- Expand and better manage sanctuary areas, building on proven models such as community-based co-management initiatives
- Improve cross-border coordination for migratory species

Effective management safeguards stock health while reducing volatility and congestion-driven losses.

• **Enhance Export Competitiveness and Diversification:** Export resilience must be strengthened in anticipation of post-LDC graduation (2026).

- Support technology adoption, such as Vannamei shrimp farming, with strict biosecurity safeguards
- Strengthen SPS laboratory capacity, traceability, and cold handling at ports and airports
- Diversify export markets beyond the EU to reduce regulatory and demand concentration risk

• **Mechanical Wet Market:** To improve efficiency and hygiene in traditional wet markets, the introduction of mechanical fish descaling and cutting machines is recommended, particularly during peak trading hours. At present, heavy reliance on manual processing creates significant backlogs, leading to long queues and prolonged exposure of fresh fish to ambient temperatures, which accelerates spoilage.
The use of semi-automated, stainless steel descalers and specialized cutting tools can substantially reduce processing time per unit. This form of mechanization helps preserve freshness and organoleptic quality, enhances food safety by minimizing manual handling, and improves overall cleanliness and hygiene within the marketplace.

These measures protect export earnings while reducing exposure to compliance shocks.

Table 19: Summary of Priority Interventions and Delivery Framework

Priority Area	Key Actions	Primary Responsibility	Delivery Model
1. First-Mile Loss Reduction (Highest ROI)	Onboard icing; farm/landing ice access; insulated containers; handling training	DoF, BFDC, Private suppliers	DoF, BFDC, Private suppliers
2. Insulated Transport Systems	Insulated vans/boxes on key corridors; leasing incentives	MoFL, MoT, Private logistics	Market-led with policy incentives
3. Live Fish Transport Systems	Aerated tanks; transport standards; operator training	DoF, Private traders	Private sector–driven
4. Shrimp Seed System Reform	Expand SPF hatcheries; regulate PL movement; certification	DoF, BFRI, Private hatcheries	Public regulation + private investment
5. Wholesale Market Modernization	Cold rooms, covered auctions, sanitation, and drainage	City Corporations, LGED	Public investment + concessions
6. Export & SPS Readiness	Lab capacity; traceability; cold handling at ports/airports	DoF, Plant Quarantine, CAAB	Public investment + private operations

Expected Outcomes

• **25–50% reduction** in post-harvest losses for priority fisheries products
• **Higher producer price** realization and reduced volatility
• Improved food availability **without increasing fishing pressure**
• **Stronger export resilience** under stricter SPS and post-LDC trade conditions.

06

System Mapping – Livestock Sub-Sector

6.1. Sector Overview and Relevance of Selected Livestock Products

Bangladesh's livestock sector is a vital pillar of nutrition, livelihoods, and the agricultural economy, contributing an estimated **14–16% of agricultural GDP** and supporting the incomes of millions of smallholder households, particularly women and land-poor farmers. **Milk, meat, poultry, and eggs** constitute the primary sources of animal protein in the national diet, with demand rising steadily due to population growth, urbanization, and changing consumption patterns. In recent years, Bangladesh has achieved self-sufficiency in meat production and now maintains a surplus in cattle, signaling strong production-side performance.

Despite these gains, the sector remains highly fragmented and informal. An estimated 70–90% of livestock transactions occur through informal channels, and traditional wet markets account for over 95% of retail sales, typically with limited hygiene, quality control, or temperature management (DLS, 2024; UNIDO, 2019). As a result, quality assurance is weak, price signals are opaque, and producers capture only a small share of final consumer value.

Agro-logistics constraints, rather than production shortfalls, are now the dominant bottleneck. Livestock products are inherently perishable, and quality deterioration begins immediately after milk collection, animal slaughter, or egg laying. Yet cold chain infrastructure currently serves only about 10% of perishable dairy and less than 7% of meat products, leaving most flows exposed to heat stress, delayed handling, and contamination risks (World Bank, 2025; DLS, 2024). Live-animal transport stress, informal slaughter systems, and congested wholesale markets further exacerbate post-harvest losses and value erosion, even when physical spoilage is not immediately visible.

Export performance illustrates this disconnect between production potential and logistics readiness. Despite cattle surplus and growing commercial poultry and dairy segments, livestock exports remain negligible due to the absence of comprehensive WOAH disease-free certification, challenges in obtaining internationally recognized halal certification, and inadequate cold chain and processing infrastructure to meet importing-country standards (DLS, 2024). These gaps limit access to high-value regional and Middle Eastern markets, constraining the sector's ability to transition from volume-driven growth to value-led expansion.

This study focuses on **five livestock commodities** that together capture the diversity of production systems, perishability profiles, and agro-logistics challenges in Bangladesh:

• **Milk and Dairy Products:** The most logistics-intensive livestock commodity due to daily production cycles, rapid spoilage, and high sensitivity to temperature abuse; losses are concentrated at the first mile in the absence of chilling.

• **Beef (Cattle):** Predominantly supplied through live-animal markets and informal slaughter, resulting in transport stress, weight loss, food safety risks, and weak traceability.

• **Goat and Sheep (Mutton):** Widely produced by smallholders across dispersed geographies, creating aggregation inefficiencies and live-transport losses.

• **Poultry Meat:** The fastest-growing livestock segment, characterized by high disease sensitivity, dense production clusters, and reliance on live-bird markets.

• **Eggs:** Relatively more durable than fresh meat and milk, yet highly vulnerable to breakage, heat stress, and handling losses under informal logistics systems.

Collectively, these products account for the largest share of livestock output and consumption, exhibit distinct post-harvest risk profiles, and are central to domestic food security, income generation, and future export ambitions. Their inclusion enables a comprehensive assessment of how agro-logistics constraints, across cold chain availability, transport, market structure, and certification, shape economic outcomes in Bangladesh's livestock sector.

6.2. Production Trend, Geography, Concentration, and Seasonality

Livestock production in Bangladesh exhibits strong regional patterning combined with pronounced seasonal dynamics, both of which critically shape agro-logistics requirements, market access, and post-harvest loss outcomes. While overall production has expanded steadily across most commodities, the spatial concentration of production and temporal clustering of demand generate recurring bottlenecks in transport, slaughter, storage, and market infrastructure.

6.2.1. Production Trend and Commodity-wise Growth

Livestock production has shown **consistent multi-year growth,** driven by rising domestic demand, improved breeds, and the expansion of commercial poultry and dairy systems. However, growth trajectories vary by commodity, reflecting differences in biological cycles, disease exposure, and market structure.

Table 20: Livestock Production Trends (FY 2019–20 to FY 2023–24)

Commodity	FY 2019–20	FY 2020–21	FY 2021–22	FY 2022–23	FY 2023–24 (Est.)	Growth Trend
Milk (Million MT)	10.90	11.92	13.07	13.74	14.10	+3–5% annually
Beef & Buffalo Meat (Million MT)	5.59	6.03	6.70	6.80	7.00	+4–6% annually
Goat & Sheep Meat (Million MT)	0.68	0.73	0.85	0.88	0.92	+3–4% annually
Poultry Meat (Million MT)	1.35	1.53	1.72	1.62	1.73	Variable (disease-driven)
Eggs (Billion units)	19.50	21.20	23.35	24.50	25.80	+5–7% annually

Source: Synthesized from Department of Livestock Services (DLS) "Livestock economy at a glance" series (2019–2024; incl. 2024–2025 edition).

Milk and eggs show the most stable upward trajectories, reflecting daily consumption patterns and strong urban demand. Poultry meat growth is more volatile, reflecting recurrent disease outbreaks and market shocks. Red meat production has increased steadily, yet remains heavily constrained by live-animal logistics and informal slaughter systems.

6.2.2. Production Geography and Concentration

Livestock production is geographically dispersed overall, but individual commodities exhibit distinct clustering patterns that have important implications for aggregation efficiency, cold chain feasibility, and transport costs.

Table 21: Key Production Areas and Geographic Concentration

Commodity	Top 5 Producing Districts/Regions	Production Characteristics
Raw Milk	Pabna-Sirajganj (traditional milk belt) Rangpur Division (Northern zone; high production, low prices) Gazipur-Savar (peri-urban Dhaka) Manikganj-Tangail (Milk Vita collection zones) Natore, Dinajpur	Concentrated in northern districts where feed (maize, grass) is abundant; peri-urban zones serve the Dhaka market with premium prices
Beef Cattle	Nationwide distribution (less concentrated than milk) Pabna, Sirajganj (feedlot zones) Dhaka periphery (~5,000 commercial fattening farms) Mymensingh (cattle population hub) Chittagong (regional beef demand center)	Cattle rearing is dispersed; fattening is concentrated near urban demand centers; Eid al-Adha drives seasonal concentration in the Dhaka region
Goat Meat	All districts (highly dispersed; backyard rearing) Coastal regions (Black Bengal goat dominance) Mymensingh, Chittagong Hill Tracts Rangpur Division Khulna Division	Marginal farmers nationwide; goats adapt to poor-quality grazing; less concentrated than cattle/milk
Broiler Chicken	Gazipur (major poultry belt) Dhaka Division (peri-urban farms) Chittagong Kishoreganj (layer concentration) Narsingdi, Munshiganj	Concentrated near Dhaka (market access, feed availability); contract farming clusters around integrator hubs
Table Eggs	Gazipur (layer farm concentration) Kishoreganj Dhaka Division periphery Mymensingh Cumilla	Layer farms clustered around Dhaka for market access; parent stock operations in Gazipur, Narsingdi

Source: Synthesized from DLS livestock statistics and sector overviews (2019–2024), FAO–UNIDO value chain assessment (2019), and industry overviews.

Dairy production is **regionally concentrated in northern milk belts,** where higher cattle density and fodder availability support collection-based logistics systems such as village milk collection centers. This spatial concentration creates opportunities for ***scalable chilling and aggregation,*** but also exposes the system to heat stress and seasonal transport disruptions.

In contrast, **cattle and goat production is highly dispersed,** dominated by backyard and smallholder systems across rural Bangladesh. This dispersion increases **aggregation costs,** prolongs live-animal transport distances, and amplifies weight loss, mortality, and disease transmission risks. Poultry production shows the **highest degree of clustering,** particularly around Dhaka and Chattogram, driven by proximity to feed mills, hatcheries, integrator networks, and large consumer markets. While clustering improves market access, it also concentrates biosecurity risks and creates localized congestion.

6.2.3. Seasonality and Logistics Pressure Points

Seasonality exerts a powerful influence on livestock supply flows, prices, and logistics stress, often creating short periods of extreme system overload.

Table 22: Seasonality and Peak Logistics Pressure by Commodity

Commodity	Peak Periods	Key Logistics Stress
Milk	Summer (lean season)	Heat-induced spoilage; reduced yields
Beef (Cattle)	Eid-ul-Azha	Transport congestion; slaughter capacity overload
Goat & Sheep	Eid-ul-Azha	Aggregation stress; informal slaughter
Poultry	Year-round, with disease peaks	Biosecurity and mortality risks
Eggs	Summer	Breakage and heat-related quality loss

Source: Synthesized from DLS market/sector reporting and value chain assessments; poultry disease dynamics from peer-reviewed studies.

The most extreme seasonal shock occurs during **Eid-ul-Azha,** which drives a massive, short-duration spike in demand for cattle and goats. It is estimated that **over 60% of annual cattle slaughter occurs within a three-day window,** overwhelming transport routes, live markets, and slaughter facilities. Animals are moved long distances under crowded conditions, resulting in significant weight loss, stress, and food safety risks.

During the **monsoon season** (July–September), flooding disrupts transport routes and feed supply chains, while high humidity and heat increase disease prevalence. In **summer months,** heat stress reduces milk yields by an estimated **20–30%,** increases poultry mortality, and accelerates spoilage across all perishable livestock products due to weak cold chain penetration.

The interaction of regional concentration and seasonal demand spikes creates recurring, predictable pressure points in Bangladesh's livestock supply chains. **Northern dairy belts** require robust first-mile cooling and insulated transport to manage heat stress, while peri-urban poultry clusters demand enhanced biosecurity and market buffering. Highly dispersed **cattle and goat systems** require better aggregation, humane transport, and slaughter infrastructure, particularly during festival peaks. Addressing these geography- and season-specific constraints is essential for reducing post-harvest losses, stabilizing prices, and improving overall system efficiency.

6.3. Climate Vulnerability Analysis

Livestock production and distribution systems in Bangladesh are increasingly exposed to climate-related stresses that directly undermine animal productivity, product quality, and agro-logistics efficiency. Rising temperatures, erratic rainfall, flooding, and recurrent disease outbreaks interact with weak cold chain infrastructure and informal market systems, amplifying post-harvest losses and economic risk across livestock commodities.

Heat stress represents the most pervasive climate threat. Prolonged summer temperatures reduce cattle fertility and productivity across species. Crossbred **dairy cattle** are particularly vulnerable, with feed intake reduced by 40% at 40°C and milk yields declining by 20–30% during peak heat periods, while accelerated bacterial growth sharply reduces raw milk shelf life when cooling is delayed (Hossain et al., 2012; Ali et al., 2020; Salauddin et al., 2025). **Poultry systems** face even higher sensitivity; heat stress elevates mortality, lowers feed conversion efficiency, and increases disease susceptibility, especially in densely stocked commercial broiler and layer farms.

Flooding, driven by monsoon rainfall and river overflow, disrupts **livestock logistics** through multiple channels. Inundated roads delay milk collection and animal transport, isolate farms from markets, and interrupt feed supply chains

(Hossain et al., 2012; Ali et al., 2020; Salauddin et al., 2025). Poultry operations are especially exposed, as waterlogging increases pathogen loads and facilitates rapid disease transmission. Cattle and small ruminants are moderately resilient but still experience stress, reduced weight gain, and higher mortality during prolonged floods.

Disease outbreaks remain a chronic climate-linked risk as climate expands pathogen windows via humidity/temperature. Highly Pathogenic Avian Influenza continues to pose the greatest threat to **poultry and egg systems,** periodically triggering mass culling and severe supply disruptions. Foot-and-Mouth Disease (FMD) affects **cattle** productivity and restricts animal movement, while Peste des Petits Ruminants (PPR) periodically causes high mortality in **goats and sheep** (Hossain et al., 2012; Ali et al., 2020; World Bank, 2024; Salauddin et al., 2025).

Table 23: Climate Vulnerability Matrix of Livestock Commodities

Risk Factor	Milk	Cattle	Goat/Sheep	Poultry	Eggs
Eggs	Very high	High	Moderate	Very high	High
Flooding	Moderate	Moderate	Moderate	High	Moderate
Disease outbreaks	Moderate	Moderate	Moderate	Very high	High

Source: Synthesized from Hossain et al. (2012); Ali et al. (2020); World Bank, 2024; Salauddin et al. (2025)

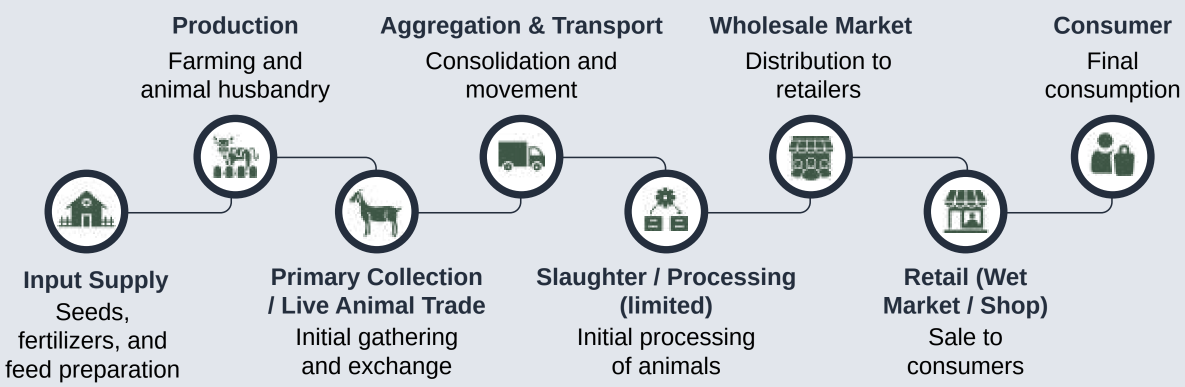
6.4. Value Chain Structure of Selected Livestock Products

Livestock value chains in Bangladesh are **predominantly informal, live-animal or fresh-product oriented, and intermediary-driven,** with limited processing and cold chain integration outside a few formal segments (notably branded dairy and poultry integrators). While the core stages are similar across commodities, handling intensity, preservation options, and actor power vary sharply by product, shaping post-harvest loss profiles and price outcomes.

6.4.1. End-to-End Value Chain Mapping for Livestock Products

Across commodities, the generalized livestock value chain follows this sequence:

Generalized End-to-End Livestock Value Chain



The absence of a structured cold chain, standardized slaughter, and contract-based procurement defines most domestic livestock chains.

End-to-End Commodity-Wise Value Chain Architecture

Stage	Milk & Dairy	Beef (Cattle)	Goat/Sheep (Mutton)	Poultry Meat	Eggs
Production	Smallholder dairy farms (1–3 cows)	Backyard & semi-commercial cattle fattening	Backyard small ruminants	Commercial & semi-commercial farms	Layer farms
Primary Collection / Trade	Local milk collectors (morol)	Local cattle traders (Bepari)	Village traders	Live bird traders	Egg traders
Aggregation	Chilling centers (limited) or direct to traders	Hats (live animal markets)	Weekly hats	Bird markets	Sorting sheds
Processing / Slaughter	Minimal; pasteurization only in formal dairy	Informal slaughter (≈ 95%)	Informal slaughter	Informal slaughter (wet markets)	None
Wholesale	Dairy processors / urban wholesalers	Meat wholesalers	Meat wholesalers	Poultry wholesalers	Egg wholesalers
Retail	Wet markets, dairy shops, brands	Wet markets	Wet markets	Live bird shops	Grocery & wet markets
Cold Chain Use	~10% (formal dairy only)	Negligible	Negligible	Very limited	Minimal
Market Orientation	Domestic	Domestic	Domestic	Domestic	Domestic

Source: FAO–UNIDO value chain assessment (2019), DLS reporting, and cold chain studies for livestock value chains

6.4.2. Commodity-Specific Value Chain Characteristics

A. Milk and Dairy Products Value Chain: Milk has the **most time-sensitive and logistics-intensive chain.**

- Daily production with **no on-farm storage**
- Heavy dependence on **local collectors**
- Spoilage risk begins within 2–4 hours without chilling
- Only ~10% enters formal cold chains (branded processors)

• **Key bottleneck:** First-mile chilling and transport
• **Dominant loss form:** Quality downgrade (souring), distress sale

B. Beef (Cattle) Value Chain: Beef flows almost entirely through **live-animal markets and informal slaughter.**

- Long-distance live transport causes **3–5% live-weight loss**
- Peak demand during **Eid-ul-Azha** overwhelms logistics
- Cold storage and carcass transport are virtually absent

• **Key bottleneck:** Live animal transport, informal slaughter
• **Dominant loss form:** Weight loss, hygiene-related value erosion

C. Goat and Sheep (Mutton) Value Chain: The most **dispersed and fragmented livestock chain**.

- Backyard production dominates
- High mortality during transport
- No scale economies in aggregation
- Very high festival-driven price volatility

• **Key bottleneck:** Aggregation and live transport
• **Dominant loss form:** Mortality and price discounting

D.Poultry Meat Value Chain: The **fastest-moving and most disease-sensitive chain.**

- Predominantly live-bird markets
- Mortality risk embedded in prices
- Disease outbreaks like Avian Influenza (AI) cause sudden supply shocks
- Minimal processing despite high volumes

• **Key bottleneck:** Biosecurity, live-bird transport
• **Dominant loss form:** Mortality, forced market clearance

E. Eggs Value Chain: Relatively less perishable but **highly handling-sensitive.**

- Breakage (4–6%) is common
- Heat stress reduces hatchability and quality
- No cold storage; ambient transport dominates

• **Key bottleneck:** Packaging and heat exposure
• **Dominant loss form:** Physical damage and quality downgrade

Structural features include dominant live animal transport (increasing stress/mortality), prevalent informal slaughter for red meat, fragmented cold chains (stronger in poultry/dairy), and limited formal contracts outside commercial segments.

6.4.3. Market Value and Pricing Trend

Livestock pricing in Bangladesh is shaped less by formal cost structures and more by perishability, seasonality, informal intermediation, and weak cold chain integration. Across milk, meat, poultry, and eggs, prices escalate sharply from farm-gate to retail due to handling losses, transport inefficiencies, live-animal stress, and intermediary margins rather than value-adding services. As a result, **producer price realization remains low, while consumers face high and volatile prices.**

An estimated **70–90% of livestock transactions occur in informal markets,** where prices are determined through spot bargaining rather than transparent auction or contract systems. Traditional wet markets dominate (over 95% of sales), limiting incentives for quality differentiation, grading, or cold chain investment.

Farm-Gate, Wholesale, and Retail Price Structure

Prices differ substantially by commodity depending on perishability, transport mode (live vs carcass), seasonality, and disease risk.

Table 24: Indicative Price Structure Across the Livestock Value Chain (BDT)

Commodity	Farm / Producer Price	Wholesale Price	Retail Price	Key Price Drivers
Raw Milk (per liter)	35–45	55–65	70–90	Lack of chilling, bacterial spoilage risk, distance to urban markets
Beef (per kg, carcass equiv.)	420–520	650–750	800–950	Live animal stress, informal slaughter, Eid demand
Goat Meat (per kg)	650–750	900–1,050	1,100–1,300	Small animal size, high mortality, festival demand
Broiler Chicken (per kg)	140–180	190–230	260–320	Disease outbreaks (AI), live-bird mortality, feed prices
Eggs (per piece)	8.5–10.0	10.5–12.0	12.5–15.0	Breakage, heat stress, transport damage

Indicative ranges synthesized from DLS market bulletins, KIIs, and urban wholesale market observations.

Price Escalation and Margin Distribution

Across commodities, **retail prices are typically 60–120% higher than farm-gate prices,** with the largest margin accrual occurring at the aggregation and retail stages, not through processing or quality enhancement.

Key contributors to price escalation include:

- **Milk:** Absence of chilling forces distress sales at the farm-gate; souring risk pushes margins to collectors and retailers.

- **Beef & Goat:** Live animal transport causes 3–5% weight loss (cattle) and 6–10% mortality (goats), embedded into prices.

- **Poultry:** Live bird markets internalize mortality and disease risk through higher wholesale markups.

- **Eggs:** 4–6% breakage and heat damage inflate downstream margins.

In most cases, **price increases reflect risk premiums,** not improved handling, cold storage, or food safety.

Seasonality, Volatility, and Shock Sensitivity

Livestock prices show **strong seasonal volatility,** driven by festivals, climate stress, and disease outbreaks.

Key seasonal price dynamics:

- **Eid-ul-Azha:** Beef and goat prices rise **30–50%** in the weeks before Eid, followed by sharp post-Eid crashes.

- **Monsoon (Jul–Oct):** Milk supply drops due to heat stress and feed shortages; prices rise **10–15%.**

- **Summer heat waves:** Poultry mortality increases; chicken prices spike.

- **Disease shocks (AI, FMD, PPR):** Sudden supply contractions cause short-term price inflation and long-term producer exits.

Price volatility is amplified by the lack of storage, processing buffers, and contract-based supply arrangements.

Informality, Bargaining Power, and Price Transmission

Price transmission from retail to producer is weak:

- **Smallholders are price takers,** especially in milk and goats, where immediate sale is mandatory.

- Live animal traders and wholesalers capture a disproportionate share of value by controlling timing, transport, and market access.

- Quality differentiation is minimal; better hygiene or animal welfare **rarely earns a premium** in informal markets.

In contrast, formal processors (dairy brands, poultry integrators) exhibit more stable pricing but still cover only a small share of total volume.

Export Pricing (Limited but Indicative)

Livestock exports remain negligible, but indicative pricing highlights missed value:

- **Export-grade halal beef** can earn USD 4.5–6.0/kg FOB, compared to domestic retail prices of USD 7–8/kg without a cold chain.

- Lack of WOAH disease-free status, modern abattoirs, and cold logistics prevents scale-up despite surplus cattle availability.

Key Market Insights

- **Value erosion outweighs visible spoilage:** most losses occur through quality downgrade, distress sales, and risk discounting.

- **Cold chain absence directly suppresses farm prices,** particularly for milk and poultry.

- **Price volatility discourages investment** in improved handling, creating a low-equilibrium trap.

- Addressing **logistics and market structure**, not production, offers the highest leverage for improving producer incomes and stabilizing prices.

6.4.4. Actor Ecosystem by Commodity

Livestock value chains in Bangladesh are characterized by a **highly asymmetric actor ecosystem,** where market power, risk exposure, and value capture vary significantly by commodity but follow a consistent structural pattern: producers absorb most biological and logistics risk, while intermediaries and retailers capture the largest margins. The dominance of informal markets, live-animal trade, and weak contractual arrangements reinforces this imbalance across milk, meat, poultry, and eggs.

Core actors include:

• **Smallholders:** Highly dependent with minimal bargaining power, especially in dairy and small ruminants.
• **Traders:** Dominate chains, control access, and transfer logistics risks to producers through low prices.
• **Wholesalers:** Gatekeep urban markets, leveraging congestion and perishability to suppress purchase prices.
• **Processors:** Influence is strong but limited to formal segments (e.g., dairy), absent in informal meat chains.
• **Retailers:** Hold high pricing power, decoupling consumer prices from farm-gate costs.
• **Regulators:** Weak and uneven oversight, perpetuating informality and safety risks.

Table 25: Actor Roles and Influence Across Livestock Value Chains

Actor Category	Milk	Beef (Cattle)	Goat/ Sheep	Poultry	Eggs
Smallholders / Producers	High dependence	Moderate	Very high	Moderate	Moderate
Traders / Bepari	High	Very high	Very high	High	High
Wholesale Agents	Moderate	High	High	High	High
Processors	Strong (limited volume)	Weak	Absent	Weak	Absent
Retailers	High pricing power	Very high	Very high	High	High
Regulators	Moderate	Weak	Weak	Moderate	Low

Across all livestock commodities, the actor ecosystem reinforces a **risk-reward imbalance:**

• **Producers** bear biological, climate, and first-mile logistics risks
• **Intermediaries and retailers** capture margins linked to scarcity and volatility
• **Processors** influence quality and prices only where cold chain exists
• Weak **regulation** sustains informality and discourages investment

This structure explains why improvements in production alone have not translated into higher farmer incomes or reduced consumer prices.

Addressing agro-logistics bottlenecks, particularly **first-mile cooling, live-animal transport standards, slaughter infrastructure, and market formalization,** is essential to rebalance actor power, reduce value erosion, and improve overall efficiency of livestock value chains.

6.5. Post-Harvest Loss Analysis of Selected Livestock Products

Bangladesh's livestock supply chains are **highly informal (70–90% transactions)** and **wet**

markets dominate (>95% of sales), two structural conditions that amplify post-harvest loss through weak cold chain coverage, inconsistent hygiene, and fragmented logistics.

6.5.1. Post-Harvest Handling Practices (On-Farm / First Mile)

Post-harvest handling at the farm and the immediate collection stage is the primary loss hotspot across all livestock commodities. Practices remain largely informal, with limited hygiene control, negligible cooling, and minimal record-keeping. As a result, quality deterioration often begins **before products enter formal markets,** shaping downstream losses and price penalties.

Table 26: On-Farm / First-Mile Post-Harvest Handling Practices and Risk Drivers

Practice Element	Milk	Beef (Cattle)	Goat	Broiler	Eggs
Hygiene standards	Hand milking common; limited udder, utensil, and container sanitation	Limited washing; poor manure management at holding points	Minimal hygiene in backyard systems	SOPs improving in commercial farms; biosecurity uneven	Automated collection in large farms; washing/candling at packers
Cooling at source	None in traditional systems; limited bulk chillers; small solar VMCC pilots	Not applicable (live animals)	Not applicable	Not applicable (live birds)	Not applicable (ambient handling)
Storage duration at farm	<2 hours without chilling; <24 hours if chilled	Short holding with feed/water before transport	Minimal holding	Immediate dispatch	Stored up to ~48 hours
Quality control	Informal sensory checks (smell/appearance)	Visual health inspection only	Visual health inspection only	Weight gain and mortality tracking	Candling and basic grading
Record keeping	Minimal and informal	Limited	Rare	Relatively detailed in commercial systems	Production and batch logs common

Source: Synthesized from FAO–UNIDO (2019) value chain assessment, cold chain studies, and sector overviews.

Key implications for agro-logistics:

• **Milk** faces the highest first-mile risk due to extreme time–temperature sensitivity. Without rapid cooling to ≤4°C, spoilage and souring can begin within hours, forcing distress sales and quality downgrades.

• **Beef and goat** losses are driven less by spoilage and more by **live-animal stress,** dehydration, and injury during pre-transport holding and movement to markets.

• **Broiler poultry** is highly sensitive to handling stress and disease exposure; mortality risk is embedded in pricing even before transport.

• **Eggs,** while less perishable biologically, incur early losses through **breakage and heat exposure,** especially where handling and stacking are poor.

Overall, **first-mile weaknesses,** lack of cooling for milk, and stress-intensive live transport for animals and eggs, determine much of the downstream loss and value erosion observed across livestock value chains. Addressing these early-stage practices offers the highest return for loss reduction.

6.5.2. On-Farm Storage / Chilling Availability

Cold storage and chilling at the farm level remain **extremely limited** across livestock commodities, resulting in delayed cold-chain entry and early quality deterioration. Where cooling exists, it is largely off-farm and selective, serving only a small share of total production.

Table 27: On-Farm Storage Availability and Cold-Chain Entry Points

Commodity	On-Farm Storage / Cooling	Off-Farm Collection Points	Estimate Cold-Chain Entry / Coverage
Milk	<5% of farms equipped with bulk milk coolers; solar VMCC pilots cover <1%	VMCCs and chilling centers linked to dairy hubs (e.g., Milk Vita, BRAC/Aarong, PRAN, Akij)	~9% enters formal cold chain
Beef (Cattle)	Not applicable (live animals)	Slaughter points and markets	<2% post-slaughter (mainly export-oriented facilities)
Goat/Sheep	Not applicable	Haats and local markets	<1% (negligible)
Broiler	Not applicable (live birds)	Processing plants with cold rooms	~10–15% (processed chicken segment)
Eggs	Ambient storage for 24–48 hours at farm	Wholesaler warehouses; limited refrigeration in modern retail	~5% (mainly modern retail)

Source: Cold chain coverage constraints and entry points synthesized from livestock cold chain studies and World Bank cooling assessments; triangulated with DLS reporting and sector overviews.

Key implication: For most livestock products, **cold-chain entry occurs late, if at all.** Milk is the only commodity with a partially structured chilling network, yet over 90% still moves through ambient systems. For meat, poultry, and eggs, the absence of on-farm or early-stage cooling means that first-mile losses and quality degradation are largely irreversible, constraining value addition, food safety, and export potential.

6.5.3. Packaging Materials and Practices

Packaging and containment practices in livestock value chains are largely informal and function-oriented rather than quality- or temperature-protective. With limited use of insulated or standardized containers, packaging itself becomes a significant driver of both physical loss and quality degradation, particularly during first-mile and midstream transport.

Table 28: Packaging / Containment Practices and Associated Loss Risks

Product	Common Containment / Packaging Practice	Loss Mechanism Triggered
Milk	Milk cans and non-insulated metal/plastic containers; buckets; limited use of insulated or refrigerated tanks	Contamination and rapid temperature rise leading to souring, rejection, and distress sales
Milk	Live transport in open trucks (standing animals); post-slaughter movement without cold chain; retail sale as exposed “hanging meat”	Stress and live-weight loss during transport; microbial growth, dehydra-tion, and hygiene-related value loss in open handling
Goat	Live transport in pickups and small trucks, often overcrowded	High mortality and stress; bruising and meat quality deterioration
Broiler	Live birds in crates on open pickups/trucks; limited cold rooms and reefers for processed chicken	Heat stress, injury, and market mortali-ty; constrained expansion of chilled/-frozen poultry due to weak cold chain
Eggs	Plastic trays and crates moved by motorcycle, pickup, or truck under ambient conditions	Breakage from vibration and stacking; heat-related quality decline (shell weakness, internal degradation)

Source: Synthesized from FAO–UNIDO (2019) value chain description and cold chain/handling constraints literature.

Key implication: Across commodities, packaging is designed primarily for movement rather than protection. The absence of insulated containers, shock-absorbing systems, and temperature control amplifies losses from heat, vibration, stress, and contamination, making packaging improvement a low-cost, high-impact entry point for reducing post-harvest losses in livestock value chains

6.5.4. Reasons for Post-Harvest Loss of Livestock Products

Post-harvest losses in livestock value chains arise from **stage-specific failures,** beginning at the first mile and compounding through aggregation, transport, and retail. While loss mechanisms differ by commodity, they are underpinned by **common systemic weaknesses,** notably low cold-chain coverage, informal markets, and weak hygiene and biosecurity standards.

Table 29: Post-Harvest Loss Causes Matrix (First Mile to Mid-Stream to Downstream)

Stage	Cross-Cutting Causes	Milk	Beef / Goat	Broiler	Eggs
First Mile (Farm / Collection)	Minimal infrastruc-ture; weak handling standards; limited cold chaint	Delayed cooling to ≤4°C; poor hygiene during milking and collection	Transport stress and dehydration during live movement	Heat stress in open transport; high disease exposure	Rough handling and vibration causing breakage
Mid-Stream (Aggregation & Transport)	Fragmented interme-diaries; poor market and transport infrastructure	Informal aggre-gation without testing or refrigeration	Haats with poor shelter, water, and feed; holding for 1–4 days;	Live Bird Markets (LBMs) with severe biosecurity	Ambient stacking and limited care during transport

Table 29: Post-Harvest Loss Causes Matrix (First Mile to Mid-Stream to Downstream)

Stage	Cross-Cutting Causes	Milk	Beef / Goat	Broiler	Eggs
			limited veterinary checks	gaps and mixed sourcing	
Downstream (Wholesale & Retail)	Wet-market dominance; minimal refrigeration and hygiene	Continued exposure to ambient temperatures	Open-air “hanging meat” and unhygienic stalls	On-site slaughter in wet markets with poor sanitation	Ambient retail with little or no cold display
Systemic Factors	Low cold-chain penetration; disease outbreaks; export barriers	Weak last-mile cold chain and unreliable power in rural nodes	Predominance of informal slaughter	Endemic Avian Influenza and LBM structure	Minimal refrigeration outside modern retail

Source: Synthesized from FAO–UNIDO (2019) value chain constraints, national food loss studies (FPMU/WFP), World Bank cooling assessments, and poultry disease evidence.

Key insight: Losses are **cumulative rather than isolated,** with early-stage failures, particularly lack of cooling for milk and stress-intensive live transport for animals, locking in downstream quality degradation. Without strengthening first-mile infrastructure and mid-stream handling standards, downstream investments alone cannot significantly reduce post-harvest losses in livestock value chains.

6.6. Current Infrastructure, Logistics, and Capacity

Bangladesh’s livestock logistics system is characterized by high informality, weak infrastructure, and limited integration across value chain stages. Between **70–90% of livestock transactions** occur through informal channels, dominated by traditional wet markets that handle **over 95% of total sales.** Quality control, traceability, and food safety enforcement remain minimal across these channels.

Despite achieving self-sufficiency in meat production, including a surplus in cattle rearing, Bangladesh’s participation in export markets remains marginal. Export volumes are constrained by the absence of **WOAH (OIE) disease-free certification, limited internationally recognized halal certification, and severe cold-chain gaps,** particularly beyond major urban centers.

Cold Chain Infrastructure and Storage Capacity

Cold-chain availability is the most critical structural constraint across all livestock commodities:

• **Milk:** Only **~9–10% of total milk production** enters the formal cold chain. While approximately **400–600 chilling centers** exist nationwide, coverage is concentrated in northern milk belts (Pabna–Sirajganj, Rangpur), leaving southern and eastern regions underserved. Less than **5% of milk transport uses refrigerated or insulated vehicles,** leading to rapid quality deterioration.

• **Beef and Goat Meat:** Cold storage is virtually absent. Over **98% of beef** and nearly **100% of goat meat** are sold without refrigeration. Modern cold rooms are limited to a few export-oriented facilities, primarily in Dhaka, resulting in immediate sale pressure and high spoilage risk.

• **Broiler Chicken:** Cold storage exists at approximately **nine mechanized processing plants,** covering only **10–15% of production.** The remaining **85% is sold live** through wet markets without temperature control.

• **Eggs:** Refrigeration is limited to modern retail and select branded warehouses, covering roughly **5% of total volume.** The majority of eggs are stored and transported under ambient conditions.

Overall, cold-chain infrastructure currently supports **less than 10% of livestock production nationwide,** contributing directly to post-harvest losses and food safety risks.

Transport and Logistics Modalities

Livestock logistics are dominated by **non-refrigerated road transport,** with commodity-specific challenges:

• **Milk** is transported primarily via bicycles, motorcycles, and non-refrigerated vans, often in plastic containers, exposing it to heat and contamination.

• **Beef and goats** are mostly transported live, either walking short distances or standing in open trucks, leading to **3–5% live-weight** loss, dehydration, and stress.

• **Broiler chickens** are moved largely as live birds in open trucks and crates, resulting in heat stress and variable mortality.

• **Eggs** are transported in trays and crates without cushioning or temperature control, causing **4–6% breakage losses** before reaching wholesale markets.

Refrigerated transport is negligible outside a small number of export-grade or modern processing operations.

Slaughter, Processing, and Capacity Utilization

Processing infrastructure remains underdeveloped relative to production volumes:

• **Milk processing** absorbs only **~9% of total production,** despite installed capacity exceeding current utilization. Average utilization rates remain **30–40%,** driven by seasonal supply variability and quality issues at farm level.

• **Beef slaughter** is dominated by informal facilities, accounting for **90%+ of total slaughter.** Only one export-grade processor operates at scale, while municipal slaughterhouses are limited in number, capacity, and hygiene standards.

• **Goat meat** processing is almost entirely informal, with no dedicated modern facilities.

• **Broiler processing** capacity across all mechanized plants is estimated at **~50,000 birds per day,** a small fraction of national output.

• **Egg grading and packing** facilities exist but operate at low utilization, with most eggs sold ungraded.

The lack of modern abattoirs, value-added processing lines, and by-product utilization limits both domestic efficiency and export readiness.

Disease Risk, Biosecurity, and Veterinary Coverage

Infrastructure gaps are compounded by persistent animal health risks:

• **Highly Pathogenic Avian Influenza** has caused hundreds of outbreaks since 2007, with live bird markets acting as major transmission nodes.

• **Foot-and-Mouth Disease (FMD) and Peste des Petits Ruminants (PPR)** continue to disrupt cattle and goat supply chains.

• Over **60% of small-scale operations lack adequate biosecurity,** despite ongoing vaccination programs.

Veterinary services are unevenly distributed, with weak surveillance, limited laboratory capacity, and minimal enforcement at informal markets and slaughter points.

Geographic Concentration and Capacity Mismatch

Livestock production is spatially concentrated, but logistics infrastructure has not evolved accordingly:

• **Milk:** Northern districts dominate production, but cold-chain connectivity to deficit regions is weak.

• **Broiler and eggs:** Concentrated around Dhaka–Gazipur, benefiting from market proximity but facing disease and congestion risks.

• **Beef and goats:** Widely dispersed production, but slaughter and cold storage remain urban-centric.

This spatial mismatch increases transport distances, losses, and seasonal price volatility.

System-Level Implications

The combined effect of inadequate infrastructure, weak logistics, and underutilized capacity results in:

• **High post-harvest losses** (milk approximately 9 percent, meat approximately 7 percent, eggs approximately 13 percent).

• **Reduced farmer margins** due to distress sales and multiple intermediaries

• **Food safety risks** in domestic markets

• **Unrealized export potential,** despite surplus production

Addressing these challenges requires coordinated investment in cold-chain expansion, modern slaughter and processing facilities, strengthened veterinary systems, and regulatory enforcement aligned with international standards.

6.7. International Trade Dynamics and Cross-Border Flows

6.7.1. Export Opportunities and Market Constraints

Bangladesh's livestock sector, while meeting 98% of domestic meat demand and significant portions of dairy and egg requirements, remains primarily oriented toward domestic consumption with minimal export activity. Unlike horticulture and fisheries, formal livestock product exports are negligible, with total agricultural exports (which include livestock alongside other categories) reaching only $500 million in 2024, of which livestock products comprise an estimated $15-25 million.

The limited export activity concentrates in specific niche products: processed halal meat to Middle Eastern markets (primarily UAE, Saudi Arabia, Qatar), dried and processed dairy products to diaspora markets in the UK and USA, and leather and hides as raw materials or semi-processed products. The Bangladesh Agro-Processors' Association (BAPA) represents 303 active members involved in food processing, though livestock-specific exporters number fewer than 20 established companies.

Government policies provide nominal export support through a 10% cash incentive for halal meat exports and duty exemptions on capital machinery for meat processing establishments under the 2024-2027 Export Policy, yet implementation bottlenecks, absent integrated cold chain infrastructure, lacking international halal certification recognition, and insufficient SPS compliance capacity severely constrain export realization.

The **primary livestock export sector is live cattle, though this occurs almost exclusively as informal cross-border movement rather than through formal export channels,** discussed further in the border trade section below.

6.7.2. Import Dependencies and Regional Supply Chains

Bangladesh is a significant net importer of livestock products and genetic materials, creating structural dependencies on regional and international suppliers.

Dairy imports dominate livestock trade flows. Bangladesh imports substantial quantities of

milk powder (approximately 50,000-70,000 tonnes annually valued at $120-150 million) **primarily from New Zealand, Australia, Denmark, and the Netherlands,** to supplement domestic fresh milk production and meet demand for reconstituted milk, infant formula, and dairy-based processed foods. Major importers include multinational companies (Nestlé, Arla Foods) and domestic processors (PRAN, Danish).

Breeding stock and genetic materials represent another critical import category. High-yielding dairy cattle breeds (Holstein-Friesian, Jersey crossbreeds), exotic poultry breeds (Cobb, Ross broiler lines, Hy-Line laying hens), and cattle embryos/semen are imported from **Australia, New Zealand, Thailand, India, and Europe.** The Department of Livestock Services issues import permits following quarantine protocols, with animals subject to a 30-day quarantine at designated facilities in Dhaka and Chattogram.

Feed ingredients, particularly soy meal and maize for poultry and commercial dairy feeds, are imported in large volumes. Maize imports totaled significant tonnage, with Brazil constituting 80% of supplies, India 5.9%, and Myanmar 5.4% (IndexBox, 2025). Feed additives, veterinary pharmaceuticals, and specialized breeding equipment are sourced from China, India, the USA, and European suppliers.

6.7.3. Border Trade and Informal Livestock Flows

The most significant livestock trade activity occurs through **informal channels** along the India-Bangladesh border, primarily involving live cattle movement from India to Bangladesh to meet beef and draft animal demand.

While precise quantification is methodologically challenging due to the clandestine nature of informal trade, studies suggest that 1.5-2 million cattle cross the India-Bangladesh border annually through both formal and informal channels, with informal flows substantially exceeding documented imports (though these figures remain estimates subject to wide variance). Cattle originate from Indian states including West Bengal, Assam, Tripura, and Bihar, moving through border districts such as Nadia-Kushtia, Malda-Chapai Nawabganj, and Coochbehar-Lalmonirhat corridors.

Informal cattle trade operates through networks of traders (locally termed "beparis") who aggregate cattle from Indian markets, coordinate with transporters and facilitators along crossing points, and sell to Bangladeshi livestock markets in Dhaka (Gabtali), Chattogram, Sylhet, and district towns. Cattle prices in Bangladesh typically trade 20-30% higher than Indian market prices, creating economic incentives for informal flows despite legal restrictions on cattle export from India under the Prevention of Cruelty to Animals Act 1960 and various state-level bans.

India-Bangladesh border haats facilitate some legal exchange of small livestock (goats, chickens) and dairy products in border regions, though volumes remain modest. SAFTA provisions theoretically enable duty-free trade, yet practical implementation faces bureaucratic hurdles, quarantine delays, and limited awareness among small-scale livestock keepers.

Border trade with Myanmar involves minimal livestock flows, with agricultural products (discussed in horticulture and fisheries sections) dominating Bangladesh-Myanmar bilateral exchanges.

6.7.4. Sanitary Certification and Import Regulation

Livestock and livestock product imports require clearance from the Department of Livestock Services (DLS), Ministry of Fisheries and Livestock, which issues import permits following review of veterinary health certificates from exporting countries.

For live animal imports, exporting country veterinary authorities must certify freedom from notifiable diseases, including foot-and-mouth disease (FMD), peste des petits ruminants (PPR), avian influenza, Newcastle disease, brucellosis, tuberculosis, and parasitic infestations. Bangladesh requires 30-day post-arrival quarantine at government facilities in Savar (Dhaka) and Chittagong, with testing conducted by DLS laboratories and the Bangladesh Livestock Research Institute (BLRI).

Dairy product imports require health certificates attesting to pasteurization (for milk and dairy products), absence of antibiotic residues, and compliance with Codex Alimentarius standards. BFSA conducts port-level inspections and periodic sampling, though laboratory testing capacity constraints limit routine comprehensive analysis.

Meat imports (largely halal beef and poultry from Australia, Brazil, and India) require halal certification from recognized Islamic authorities and health certificates from competent veterinary authorities. The Islamic Foundation of Bangladesh provides halal certification verification, though standards harmonization with international halal certification bodies remains incomplete.

6.7.5. International Development Projects and Technical Assistance

International support to Bangladesh's livestock sector has focused primarily on **disease control, productivity enhancement, and value chain development rather than export-oriented interventions,** reflecting the sector's domestic orientation.

The **Food and Agriculture Organization (FAO)** has supported multiple initiatives, including the Emergency Centre for Transboundary Animal Diseases (ECTAD) for avian influenza and other disease surveillance, livestock census and data systems improvement, and smallholder dairy development programs. FAO technical assistance facilitated the establishment of Bangladesh's veterinary laboratory network and supported harmonization with international animal health standards under the World Organization for Animal Health (WOAH, formerly OIE) framework.

The World Bank, through projects including the Livestock and Dairy Development Project (closed) and ongoing agricultural development programs, has invested in artificial insemination services, feed mills, veterinary service delivery systems, and livestock market infrastructure. The current World Bank portfolio includes components supporting private sector participation in dairy value chains and strengthening livestock disease surveillance.

The Asian Development Bank's agricultural sector support includes components addressing livestock productivity, with investments in feed value chains, breeding programs, and rural livelihood diversification incorporating small ruminant (goat, sheep) production systems.

USAID programming has supported livestock health through the RESPOND project (addressing antimicrobial resistance and zoonotic disease surveillance) and nutrition-focused interventions integrating livestock as a pathway to improved protein intake in rural households.

The **Australia Centre for International Agricultural Research (ACIAR)** has partnered with BLRI and Bangladeshi universities on cattle and buffalo productivity research, feed optimization, and heat stress adaptation strategies under climate change.

While these projects have strengthened domestic livestock systems, dedicated export-oriented interventions remain limited, reflecting market realities where import substitution and food security objectives dominate over export development.

6.8. Strategic Analysis & Way Forward – Livestock Sub-Sector

6.8.1. Cumulative Loss and Economic Impact

Post-harvest losses in Bangladesh's livestock sector are **structural, cumulative, and value-eroding rather than purely physical.** Losses occur through spoilage, mortality, weight loss, quality downgrade, distress sales, and hygiene-related price discounts across milk, meat, poultry, and eggs.

Based on available loss estimates and market values:

• **Milk:** Around 9% post-harvest loss, primarily from souring and rejection due to lack of first-mile cooling.

• **Meat (beef/goat):** ~7% aggregate loss, dominated by live-weight loss (3–5% cattle; 6–10% goats), mortality, and hygiene-driven devaluation.

• **Poultry:** 5–9% losses under normal conditions, rising sharply during disease outbreaks.

• **Eggs:** Approximately12–13% loss, driven by breakage and heat exposure.

In economic terms, these losses translate into hundreds of millions of USD annually, with the largest share borne by producers through lower farm-gate prices and forced sales. Importantly, **value erosion (price discounting and lost quality premiums) exceeds visible physical spoilage,** meaning that reducing losses would significantly increase effective supply and farmer income without expanding production.

6.8.2. SWOT Analysis

A consolidated SWOT perspective for the livestock sector is summarized below:

Strengths	Weaknesses
• Self-sufficiency in meat production; growing surplus in cattle. • Rapid growth in poultry and dairy production. • Strong domestic demand driven by urbanization and income growth. • Presence of anchor firms in dairy and poultry with established collection networks.	• 70–90% market informality and dominance of wet markets. • Extremely low cold-chain penetration (<10% dairy; <7% meat). • Live-animal dominated chains cause stress, mortality, and hygiene risks. • Informal slaughter and weak traceability are limiting food safety and exports.
Opportunities	**Threats**
• High returns from first-mile cooling, insulated transport, and market upgrades. • Expansion of chilled meat, processed poultry, and packaged dairy. • Growing modern retail and institutional demand. • Potential to leverage surplus cattle for halal meat exports.	• Heat stress and climate variability are increasing spoilage and mortality. • Disease outbreaks (AI, FMD, PPR) disrupting supply chains. • Persistent power and infrastructure gaps in rural areas. • Loss of export opportunities due to SPS and certification constraints.

6.8.3. Investment and Policy Implications

Evidence from the loss analysis indicates that **early-stage, low-cost interventions yield the highest economic returns,** as they prevent irreversible quality damage.

Strategic Priorities

Strengthen the First Mile (Highest ROI): For immediate reduction in sourcing, mortality, and distress sales; higher farm-gate prices.

• Expand milk chilling access through VMCCs, bulk coolers, and solar-powered units.
• Improve hygiene and handling practices at farm and collection points.
• Reduce live-animal stress through shorter holding times and better loading practices.

Insulated Transport: To ensure significant quality retention at a fraction of full cold-chain cost.

• Promote insulated milk cans, crates, and vans rather than capital-intensive reefers.
• Focus on key corridors connecting production clusters to urban markets.

Upgrade Live-Animal and Live-Bird Transport Systems: To reduce mortality, weight loss, and embedded risk premiums.

• Introduce humane transport standards, ventilation, and stocking density norms.
• Improve crate design and handling for poultry and eggs.

Slaughter and Market Modernization: To reduce hygiene-related losses and improve consumer confidence.

• Invest in hygienic slaughter facilities with basic

carcass chilling.
• Upgrade wet markets with covered platforms, drainage, and cold rooms.

Processing and Value Addition: To ensure price stabilization and reduced glut-driven losses.

• Incentivize dairy, poultry, and meat processing through fiscal and credit support.
• Promote chilled and packaged products for urban and institutional markets.

Export Readiness and SPS Compliance: To unlock export potential for beef, poultry, and dairy.

• Develop disease-free zoning and certification (WOAH-aligned).
• Strengthen halal certification, traceability, and port-side cold handling.

Table 5: Climate Risk Matrix for Selected Horticulture Crops

Priority Area	Key Actions	Primary Responsibility	Delivery Model
1. First-Mile Loss Reduction	Milk chilling, hygiene training, insulated containers	DLS, Dairy processors, Private suppliers	Public support + private service provision
2. Insulated Transport	Insulated vans/crates on key routes	MoFL, MoT, Private logistics	Market-led with incentives
3. Live-Animal & Poultry Transport	Humane transport standards, crate improvements	DLS, Traders' associations	Regulation + private compliance
4. Slaughter & Market Upgrading	Hygienic slaughterhouses, cold rooms, and sanitation	City Corporations, LGED	Public investment + concessions
5. Processing & Value Addition	Fiscal incentives, concessional finance	MoI, Banks, Private processors	Private sector–driven
6. Export & SPS Readiness	Disease-free zoning, halal/SPS labs, traceability	DLS, DoC, BSTI	Public investment + private ops

Expected Outcomes

• **25–40% reduction in post-harvest losses** across priority livestock products.
• **Higher and more stable** farm-gate prices for producers.
• Improved food s**afety and consumer confidence.**
• Increased **effective supply** without expanding herd or flock sizes.
• **Enhanced readiness** for regional and global livestock trade.

07

System Mapping – Cereals Sub-Sector

7.1 Sector Overview and Relevance of the Selected Cereal Products

The cereals sub-sector forms the backbone of Bangladesh's food system, accounting for the largest share of caloric intake, land use, and agricultural employment. Rice alone supplies more than two-thirds of daily calorie consumption, while maize and wheat play increasingly strategic roles in livestock feed, food diversification, and food security stabilization. Despite near self-sufficiency in rice, the cereals system remains highly sensitive to agro-logistics performance, particularly in post-harvest handling, storage, milling efficiency, and bulk transportation.

Bangladesh produces approximately **34–42 million metric tons (MT) of rice annually,** depending on seasonal conditions, while maize production has expanded rapidly to over **4.5 million MT,** driven primarily by demand from the poultry and aquaculture feed industries (BBS, 2023; USDA FAS, 2024). In contrast, wheat production remains limited at around **1.1–1.2 million MT,** forcing the country to rely on imports for more than 80% of domestic wheat consumption (MoF, 2024).

Cereals differ fundamentally from horticulture and fisheries in that losses are driven less by perishability and more by moisture management, storage integrity, milling inefficiency, and bulk logistics failures. As a result, cereals offer large opportunities for food availability gains through improved logistics, even with relatively modest percentage loss reductions.

This analysis focuses on three cereals:

• **Rice (Aus, Aman, Boro):** Core staple; most logistics-intensive cereal due to seasonality, drying, storage, and milling.
• **Maize:** Rapidly growing crop linked to livestock and fisheries value chains; sensitive to drying and aflatoxin risk.
• **Wheat:** Import-dependent cereal with port-centric logistics and storage risks.

Together, these cereals capture the diversity of agro-logistics challenges across domestic, industrial, and import-linked supply chains

7.2. Production Trend, Geography, Concentration, and Seasonality

7.2.1. Production Trend

Cereal production has remained broadly stable, but structural shifts are evident. Rice production is increasingly dominated by irrigated **Boro rice,** which now accounts for more than half of total output. Maize has shown consistent growth over the past decade, while wheat production has stagnated due to land constraints, yield plateaus, and disease risks such as wheat blast.

The table below summarizes recent trends based on BBS, Department of Agricultural Extension (DAE), and related sources (2023-2025 data).

Table 31: Production Trend of Selected Cereal Crops

Product	Production Trend	Key Observation
Rice (Aus, Aman, Boro)	Stable to moderate growth (record ~41 MMT milled rice equivalent in FY 2023-24)	Dominant staple; Boro leads with record outputs; overall production crossed 40 million tonnes for the first time in recent years.
Wheat	Stable to slight decline	Minor domestic role (~1.2 MMT); heavy import dependence due to competition from other rabi crops and climate impacts.
Maize	Rapid growth (record ~5.2 MMT in 2024)	Driven by strong feed demand, area expansion, and high-yielding varieties, fuel increases.

Source: BBS, DAE, USDA reports, FAO GIEWS (2023-2025).

Rice contributes more than **90% of domestic cereal consumption,** while maize contributes indirectly through animal protein supply chains. Wheat's contribution is strategic rather than volumetric, as it plays a key role in price stabilization and urban food security.

7.2.2 Production Geography and Concentration

Rice cultivation is widespread nationwide, with pronounced concentrations in surplus-producing divisions such as Rangpur, Rajshahi, Mymensingh, and Barishal, where intensive irrigation and fertile soils support high yields.

Wheat production is more concentrated in northern and western districts (e.g., Rajshahi, Rangpur divisions), where rabi season conditions are favorable but increasingly challenged by competing crops like potato and maize.

Maize exhibits strong clustering in northern districts (Rangpur, Dinajpur, Bogura), proximate to poultry feed mills, facilitating efficient forward linkages but placing localized pressure on post-harvest infrastructure.

While overall cereal production displays geographic dispersion, post-harvest handling capacity remains unevenly distributed, with surplus northern and western regions often facing bottlenecks in drying and storage during peak seasons.

Table 32: Top Producing Districts by Cereal Products

Crop	Top District (% share)	2nd District	3rd District	4th District	5th District
Rice (All Seasons)	Mymensingh (13.9%)	Rangpur (9.8%)	Bogura (8.6%)	Jashore (8.6%)	Rajshahi (8.2%)
Rice (Boro)	Mymensingh (5.0%)	Sunamganj (4.5%)	Naogaon (4.2%)	Netrokona (4.0%)	Bogura (3.8%)
Rice (Aman)	Dinajpur (5.0%)	Rangpur (4.8%)	Mymensingh (4.5%)	Rajshahi (4.2%)	Bogura (4.0%)
Maize	Dinajpur (12%)	Chuadanga (10%)	Rangpur Division (50%+)	Manikganj (6%)	Rajshahi (5%)

Crop	Top District (% share)	2nd District	3rd District	4th District	5th District
Wheat	Thakurgaon (8%)	Chapainawabganj (7%)	Natore (6%)	Rajshahi (6%)	Pabna (5%)

Note: Wheat-producing districts account for 90% of national production; the top 12 maize areas account for 80% of output. Sources: BBS (2024); BRRI (2021); BWMRI (2024); Daily Star (2025)

7.2.3 Seasonality and Logistics Pressure

Cereal harvests are distinctly seasonal, generating intense, time-bound demands on drying, threshing, and storage infrastructure.

Table 33: Cropping Calendars and Harvest Seasons

Cereal	Season	Planting Period	Harvesting Period	Peak Harvest Month	Harvest Duration	Logistics Implications
Rice - Aus	Pre-monsoon	April-May	August-September	August	6-8 weeks	High monsoon drying risks; vulnerability to rain-induced spoilage.
Rice - Aman	Monsoon	Agust-September	November-December	November	8-10 weeks	Peak storage demand; congestion in warehouses and milling facilities.
Rice - Borot	Dry/Winter	December-January	April-May	April-May	8-10 weeks	Bulk drying and storage pressure; high volume surges.
Maize - Winter	Rabi	November-December	March-April	March	4-6 weeks	Moisture-sensitive storage; rapid post-harvest handling required.
Maize - Summer	Kharif	March-April	August-September	August	4-6 weeks	
Wheat	Rabi	November-December	March-April	March-April	4-6 weeks	Short drying window; competition for labor and equipment.

Note: Boro rice accounts for 51-57% of annual rice production; winter maize accounts for 85% of total maize production. Sources: USDA FAS (2023, 2024); BRRI (2021); BWMRI (2024)

These seasonal peaks create acute pressure on drying yards, threshing services, and storage facilities, rendering cereals highly sensitive to logistics performance despite their relative non-perishability.

7.3. Climate Vulnerability Analysis

Commodities are exposed to risks, and this section elaborates on how climate, flood, drought, and pest threats vary across rice, maize, and wheat production. Rice is highly susceptible to flood and cyclone risks, especially in coastal and flash flood-prone areas, with additional vulnerability to heat stress, storage pests, and rodent damage. Maize faces moderate risks from drought and waterlogging, and is particularly sensitive to salinity and emerging pests like the fall armyworm. Wheat, while less exposed to floods and cyclones during the Rabi season, has significant risks from heat stress, especially late in the season, and is highly vulnerable to blast disease epidemics. All three crops experience moderate risks from drought and rodent damage, but wheat and maize are also challenged by waterlogging and salinity. Climate change intensifies risks, with rice and wheat most affected by rising sea levels, erratic rainfall, and shorter winters, respectively.

Table 34: Climate, Flood, Drought, and Pest Risk Matrix

Risk Factor	Rice	Maize	Wheat
Flood Risk	High (Aman, Aus in flash flood areas)	Moderate (summer maize)	Low (Rabi season)
Drought Risk	Moderate (Aus season)	Moderate (dry spell in grain filling)	Moderate (late season heat)
Cyclone Risk	High (southern coastal districts)	Low	Low
Heat Stress	Moderate (Boro late harvest)	Low-Moderate	High (terminal heat after mid-Feb)

Risk Factor	Rice	Maize	Wheat
Cold Stress	Low	Low	Moderate (early sowing)
Blast Disease	Moderate (specific varieties)	Low	High (wheat blast epidemic risk)
Stem Borer	Moderate	Moderate (fall army-worm emerging)	Low
Sheath Blight	Moderate-High	Low	Low
Storage Pests	High (weevils, borers)	Moderate (weevils)	Moderate
Rodent Damage	High (storage, field)	Moderate	Moderate
Waterlogging	Moderate (transplanted rice tolerant)	High (very sensitive)	Moderate-High
Salinity	Moderate (coastal areas)	High (very sensitive)	Moderate
Climate Change Impact	High (sea level rise, erratic rainfall)	Moderate	High (shorter winter, heat)

Sources: BRRI (2021); BWMRI (2024); USDA FAS (2024); IRRI Bangladesh (2024)

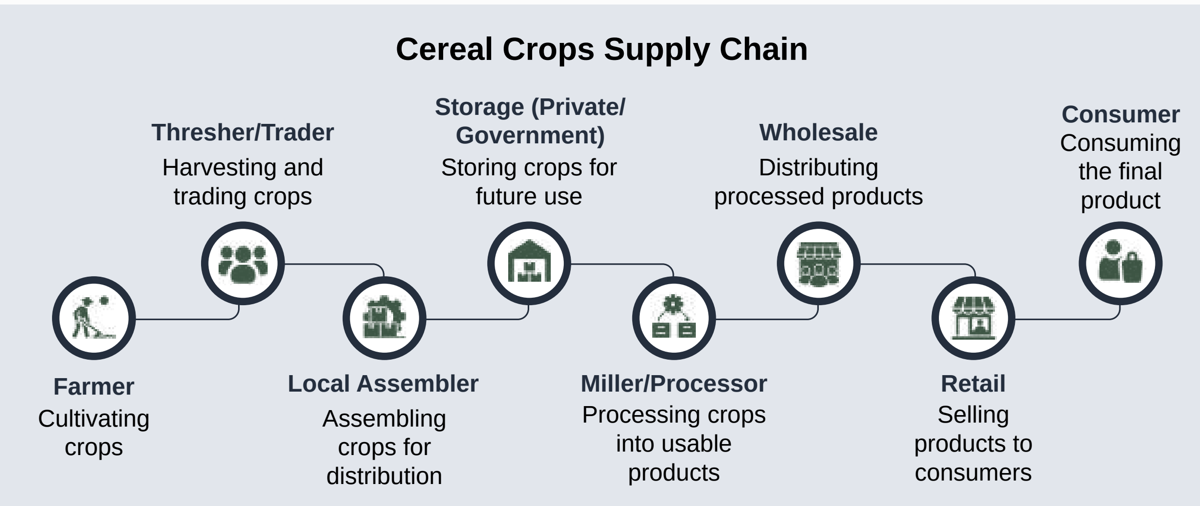
7.4. Value Chain Structure of Selected Cereal Products

Bangladesh’s cereal system operates through three parallel but structurally distinct value chains for rice, maize, and wheat. While these cereals share a common functional sequence, harvesting, drying, collection, storage, processing, and distribution, the location of value addition, loss concentration, and decision-making power differs markedly by crop. These differences shape logistics needs, investment priorities, and vulnerability to shocks.

7.4.1 End-to-End Value Chain Mapping for Cereal Products

At a functional level, all cereals move from farm to final demand through similar stages. However, rice concentrates risk upstream, maize concentrates risk at quality control and aggregation, and wheat concentrates risk at ports and bulk storage.

The generalized value chain for cereals emphasizes bulk handling and storage as critical nodes:



Key characteristics include dominance of bulk logistics, pivotal roles for drying and storage as loss-control points, and significant government involvement in rice procurement (via Directorate General of Food) and public stock management.

End-to-End Value Chain Architecture by Cereal Products

Stage	Rice (Paddy)	Maize	Wheat
Harvesting	Manual ~60% + mechanical ~40%; labor-intensive, time-sensitive	Manual harvesting + mechanical shelling	Combine harvesters + manual (highest mechanization)
Drying	Sun drying 2–3 days; weather-dependent	Sun drying 3–5 days; high moisture & aflatoxin risk	Sun drying 2–3 days; relatively low risk
Collection	Faria and farmgate traders; highly fragmented	Aggregators and feed mills; buyer-linked	Government procurement + private flour mills
Primary Storage	Golas, bags, mill storage, government depots	Warehouses; limited silos (mostly at feed mills)	Public and private silos/warehouses
Processing	Parboiling, husking, polishing (multiple steps)	Feed processing or maize milling	Flour milling
Demand Node	Wholesale markets + retail consumers	Industrial feed buyers (poultry, fish, livestock)	Flour shops and retail outlets

Comparative Insight on Value and Risk Concentration

• **Rice:** Value addition and losses are concentrated **between harvest and milling,** due to multiple processing steps (drying, parboiling, husking, polishing) and prolonged storage. The chain is **long, fragmented, and domestic,** with repeated handling and transport.

• **Maize:** Risk concentrates at **drying and aggregation,** where high moisture content and delayed handling create **aflatoxin contamination risks.** Value capture is concentrated downstream with **large feed mills,** making the chain increasingly buyer-driven.

• **Wheat:** Risk concentrates **before domestic entry,** at **ports, bulk handling, and silos.** Once milled, the domestic chain is relatively short and efficient. Value chain control is dominated by **importers, millers, and public agencies.**

7.4.2. Market Value and Pricing Trend

Price Formation Across the Chain

Cereal prices exhibit gradual escalation from farm-gate to retail, incorporating costs for drying, storage losses, transportation, milling margins, and risk premiums associated with quality deterioration and seasonal supply dynamics.

The table below presents indicative price structures (BDT/kg), reflecting recent market ranges (2024-2025 data, with notable volatility in rice).

Table 35: Indicative price structures (BDT/kg)

Crop	Farm-Gate (BDT/kg)	Wholesale (BDT/kg)	Retail (BDT/kg)	Key Price Driver
Rice (paddy/-milled)	28–33 (paddy)	45–55	55–80+	Seasonal procurement, public stock releases, and milling costs.
Wheat	30–35	40–50	50–65	Import parity, domestic supply constraints.
Maize	24–30	32–40	40–50	Feed industry demand fluctuations.

Indicative ranges based on recent market observations, USDA, and government reports (2025). Retail prices for fine rice can exceed BDT 80/kg during periods of supply tightness.

Price volatility is most pronounced in rice, influenced by procurement timing, public stock management, weather events, and government interventions.

7.4.3. Actor Ecosystem

The cereal value chain is shaped by a multi-actor ecosystem, but the relative influence of actors differs sharply by cereal, affecting how logistics systems function in practice.

Core actors include:

• **Smallholder farmers** – primary producers; dominant in rice, significant in maize, declining in wheat
• **Agricultural labor** – harvesting, drying, handling
• **Collectors (faria, bepari)** – farmgate aggregation, especially for rice
• **Transporters** – trucks, tractors, boats, rail (varying by cereal)
• **Warehouse operators** – public depots, private warehouses, silos
• **Millers/processors** – rice mills, feed mills, flour mills
• **Wholesalers and retailers** – market-based distribution
• **Government agencies** – procurement, storage, food security (DGFOOD, PFDS)
• **Importers** – critical for wheat and increasingly for maize

Table 36: Control and Coordination across Actor Ecosystem

Cereal	Dominant Actors & Control Structure	Coordination Characteristics	Key Outcomes
Rice	Smallholders, faria, traditional millers, government (limited)	Highly fragmented, trader-driven, weak vertical coordination	Multiple intra-country transfers; high handling losses; slow price transmission
Maize	Commercial farmers, feed companies, large aggregators	Buyer-driven, semi-integrated, industrial coordination	More standardized aggregation; limited wholesale role; quality-sensitive flows
Wheatt	Importers, flour mills, government agencies (DGFOOD)	Institutionally anchored, centralized, formal controls	Port-centric flows; fewer actors; large volumes; stable downstream distribution

7.5. Post-Harvest Loss Analysis of Selected Cereal Products

Post-harvest losses in the cereals sub-sector arise from a sequence of interlinked technical, infrastructural, and operational weaknesses that begin at harvest and accumulate through aggregation, storage, transport, and processing. Unlike highly perishable commodities, cereal losses are often less visible but economically significant, driven largely by **quality deterioration, moisture damage, pest infestation, spillage, and milling inefficiency,** rather than outright physical spoilage alone. Among all stages, the **first mile, farm-level operations, constitutes the single largest loss hotspot,** setting in motion irreversible quality and value erosion.

7.5.1. First-Mile Losses: Farm-Level Operations (Largest Loss Hotspot)

Farm-level post-harvest losses are consistently the highest across cereal value chains, accounting for a substantial share of total system losses. Estimated farm-level losses range from **10–15% for rice, 6–10% for maize, and 5–8% for wheat,** depending on seasonality, weather conditions, and access to basic post-harvest services.

Key Loss Mechanisms at the Farm Level

a) Harvesting Losses: Rice harvesting remains predominantly manual, with an estimated **55–65%** of rice still harvested using sickles. Manual harvesting is associated with:

• **Shattering losses of approximately 1.6–1.9%,** as mature panicles break during cutting and bundling.

• Labor shortages during peak Boro and Aman harvest seasons, leading to delayed harvesting and over-drying, which further increases shattering and grain cracking.

• In contrast, mechanized harvesting (reapers and combine harvesters), where available, reduces shattering losses and improves timeliness, but adoption remains uneven due to cost, fragmented landholdings, and limited-service availability.

b) Drying Failures and Moisture Risk: Drying is the most critical control point in cereal post-harvest management, yet it remains highly vulnerable:

• **Sun drying dominates 75–85% of cereal drying,** typically conducted on open yards, roadsides, or homestead courtyards.

• Mechanical drying capacity is limited to **approximately 5–10%,** concentrated mainly near large mills and commercial hubs.

• Dependence on sun drying exposes cereals to rain, high humidity, and re-wetting, particularly during Boro harvest (April–May) and pre-monsoon showers.

• Inadequate drying results in high grain moisture (more than 14%), leading to mold growth, discoloration, and reduced milling recovery.

c)Early Storage Losses: Once dried, cereals are often stored temporarily at the farm level in:

• Traditional **golas,** jute bags, or woven polypropylene sacks.

• These systems provide minimal protection against insects, rodents, and moisture ingress.

• Hermetic or improved storage solutions remain **below 5% of adoption,** limiting farmers' ability to safely store grain even for short durations.

Early storage losses are particularly severe for rice and maize, where insect infestation and rodent damage begin within weeks if moisture control is inadequate.

7.5.2. Aggregation and Storage Nodes: Integrity Failures

After leaving the farm, cereals pass through aggregation points such as village traders, arats, local depots, and mill storage facilities. While these nodes are critical for volume consolidation, they introduce additional loss risks.

Loss Drivers at Aggregation and Storage

• **Moisture management failures:** Grain is often re-exposed to humid conditions during loading, unloading, and short-term holding.

• **Pest infestation:** Inadequate fumigation, poor sanitation, and mixed storage of old and new grain accelerate insect damage.

• **Handling damage:** Repeated bag handling, stacking, and unstacking cause spillage and bag tearing.

Reported storage losses at aggregation nodes vary widely by facility quality, ranging from **4% in better-managed warehouses to over 10–14%** in poorly maintained traditional storage environments.
These losses disproportionately affect smallholders, who lack bargaining power and are often forced to sell immediately after harvest to avoid storage risk.

7.5.3. Mid-Stream Logistics: Transport Modal Split and Quality Deterioration

Transport is a critical mid-stream function that links farms, markets, mills, and storage facilities. Cereals logistics in Bangladesh remain dominated by bagged transport, with limited bulk handling.

Table 37: Transport Modal Split for Cereals

Mode	Share (%)	Typical Distance	Key Characteristics
Covered trucks	70–80	50–400 km	Dominant mode; bagged transport; exposure to rain if poorly covered
Rail	10–15	200–500 km	Used mainly for imported wheat and public food distribution
Inland waterways	5–10	50–300 km	Bulk flows from ports to riverine depots; cost-efficient but slow
Pickups/vans	5–10	10–50 km	Farm-to-local market or small mill transport

Source: CGSpace (2024); MACS-G20 (2023); BRRI Post-Harvest Studies; DGoF Logistics Data (Estimated)

Typical Mid-Stream Loss Mechanisms

• **Rice:** Bag tearing, spillage during loading/unloading, and moisture uptake during rain exposure in transit.

• **Maize:** High susceptibility to moisture absorption leading to fungal growth and aflatoxin contamination, especially when transported or stored without adequate ventilation.

• **Wheat:** Spillage and pest infestation during transport interruptions or storage breaks.

While transport losses per trip may appear small (often **1–3%)**, their cumulative effect across multiple handling points contributes significantly to total system losses.

7.5.4. System-Level Post-Harvest Loss Quantification and Economic Impact

Headline Loss Ranges (Harvest to Retail)

- **Rice:** 8–15 percent commonly reported; system-wide estimates rise to **15–20 percent** when storage, milling, and transport inefficiencies are included.

- **Maize:** 8–12 percent system loss.

- **Wheat:** 8–12 percent system loss.

Table 38: Monetary Loss Estimates per Metric Ton

Loss Component	Rice (USD/MT)	Maize (USD/MT)	Wheat (USD/MT)
Farm-level losses	36–55	22–33	22–33
Storage losses	11–22	7–13	7–13
Milling losses	9–20	5–12	8–18
Transport losses	4–7	2–4	2–4
Total loss per MT	**60–104**	**36–62**	**39–68**

Assumptions: Rice farmgate price 40,000 BDT/MT (USD 364); Maize 24,000 BDT/MT (USD 218); Wheat 25,500 BDT/MT (USD 232); Exchange rate 110 BDT/USD
Sources: Loss percentages from previous tables; farmgate prices from DAM Bangladesh (2024)

Even small percentage losses translate into large absolute value leakage due to the scale of cereal production.

Table 39: National-Level Annual Loss Estimates

Commodity	Production (MT)	System Loss (%)	Loss Volume (MT)	Loss Value (USD million)
Rice	~37,000,000	15–20	5.55–7.40 million	2,018–2,691
Maize	~4,500,000	8–12	0.36–0.54 million	79–118
Wheat	~1,100,000	8–12	0.088–0.132 million	20–31

Sources: Production from BBS (2024); loss percentages from analysis; values calculated

Across rice, maize, and wheat value chains, post-harvest losses are driven less by single-point failures and more by cumulative degradation across multiple weak links. The first mile sets the ceiling for quality, while deficiencies in drying, storage, transport, and milling progressively erode value. Addressing early-stage losses, particularly **timely harvesting, mechanical drying, and improved storage,** offers the highest economic return, as downstream interventions cannot fully recover value lost at the farm level.

This analysis underscores that reducing cereal losses is not primarily a production challenge but a systems-level agro-logistics challenge, requiring coordinated investments across farm services, storage infrastructure, transport standards, and processing efficiency.

7.6. Current Infrastructure, Logistics, and Capacity

The cereals logistics system remains **fragmented, partially modernized, and heavily reliant on traditional practices,** with significant gaps at the first mile, in bulk storage, and along import-linked corridors.

7.6.1. Drying Infrastructure and First-Mile Handling Capacity

Drying is the most critical first-mile operation for cereals, particularly rice, yet it remains the weakest link in the system.

What exists

• **Sun drying** dominates across all rice-growing regions, accounting for an estimated **85–90% of drying,** typically conducted on farmyards, village roads, or open threshing floors.

• Limited **mechanical dryers** are operated by large mills, contract growers, and a small number of public facilities, mainly in Boro rice clusters.

• Some farmers and traders use plastic sheets and tarpaulins to reduce re-wetting risks during sun drying.

What is missing

• Adequate **community-level mechanical drying facilities,** especially during peak Boro and Aman harvests when rainfall risk is high.

• Organized drying yards with raised platforms, drainage, and protection from traffic and contamination.

• Affordable drying services accessible to smallholders within short transport distances.

Implications: Delayed or inadequate drying leads to **high moisture retention,** which accelerates fungal growth, increases breakage during milling, and reduces storage life. These losses are often invisible at farmgate but result in **systematic quality downgrading and price discounts** downstream.

7.6.2. Storage Infrastructure: Farm, Private, and Public Capacity

Storage infrastructure for cereals exists at multiple levels but is uneven in quality, accessibility, and effectiveness.

Farm-level storage

• Most smallholders rely on **traditional storage structures** (golas, earthen bins, jute bags), offering limited protection against insects, rodents, and moisture.

• Use of **hermetic bags or metal silos** remains limited, largely due to cost and awareness barriers.

Private storage

• Traders and millers operate warehouses of varying quality, mostly **bag-based storage** without temperature or humidity control.

• Larger rice mills maintain short- to medium-term storage to manage throughput, but capacity is often fully utilized during peak harvests.

Public storage

• The government maintains a network of **public food grain warehouses and silos** under the Ministry of Food.

• While these facilities are critical for public procurement and food security operations, many are aging, geographically uneven, and insufficient relative to national production volumes.

Table 40: Storage Types and Capacity

Storage Type	Rice Capacity (MT)	Maize Capacity (MT)	Wheat Capacity (MT)	Ownership	Condition
Government Silos	400,000	Not applicable	1,200,000	Public	Modern, underutilized
Government Warehouses	1,200,000	Not applicable	600,000	Public	Poor, damp, rodent damage
Total Government	1,600,000	Not applicable	1,800,000	Public	Mixed
Private Warehouses	800,000	600,000	400,000	Private traders	Variable quality
Rice Mill Storage	2,500,000	Not applicable	Not applicable	Millers	Adjacent to mills
Feed Mill Storage	Not applicable	1,200,000	200,000	Feed companies	Modern, short-term
Flour Mill Storage	Not applicable	Not applicable	800,000	Flour mills	Silos + warehouses
Cold Storage	50,000 (seed)	20,000 (seed)	30,000 (seed)	Private	Specialized
Total National Capacity	~4,950,000	~1,820,000	~3,230,000	Mixed	Insufficient
Peak Requirement	12,000,000	1,500,000	7,000,000	-	Large gap

Storage Type	Rice Capacity (MT)	Maize Capacity (MT)	Wheat Capacity (MT)	Ownership	Condition
Capacity Utilization	40-60%	80-95%	25-40%	-	Seasonal variation

Note: Government aimed to raise silo capacity to 2.2 million MT by 2015; current status 1.6 million MT total
Sources: Mohiuddin (1988); Bangladesh Food Security Bulletin (2012); FPMU Bangladesh (2024); DGFOOD (2024)

Key gaps

• Lack of modern, pest-controlled storage near production clusters.

• Limited integration between private storage and public procurement systems.

• Inadequate buffer storage to smooth seasonal supply gluts and lean-period shortages.

7.6.3. Milling and Processing Capacity

Processing capacity is a central determinant of value retention in cereals, especially rice.

Rice milling

• Bangladesh has thousands of rice mills, but a significant share still uses **traditional or semi-automatic technology.**

• Modern automatic and semi-automatic mills have expanded, improving recovery rates and quality consistency, yet they process only a portion of total output.

• Traditional mills are associated with **higher broken rice percentages, energy inefficiency, and inconsistent quality,** contributing to hidden value loss.

Maize and wheat processing

• Maize is largely processed by **industrial feed mills,** which are relatively modern and efficient, benefiting from scale and contract-based procurement.

• Wheat milling is concentrated in a smaller number of commercial flour mills, supplemented by imports of processed flour.

Mill Type	Number of Units	Capacity (MT/hr)	Daily Capacity (MT)	Utilization Rate	Rice Recovery	Location
Auto Rice Mills	31+ documented	3.0-3.5	50-80	56%	67.5%	Major districts
Semi-Auto Rice Mills	~500	1.5-2.5	25-40	60-70%	65-67%	District towns
Engleberg Mills	1,000+	0.5-1.0	8-15	70-80%	53-55%	Rural areas
Maize Flour Mills	200+	Variable	Variable	60-75%	85-90%	Feed industry zones
Wheat Flour Mills	200+	2.0-5.0	35-100	50-70%	72-76%	Urban centers, ports
Parboiling Units	800+	1.0-3.0	15-50	65-75%	N/A	Northern districts

Note: Engleberg mills are notorious for 45-47% breakage; head rice recovery is only 30% of milled rice
Sources: BRRI (2021); Khan et al. (2024); IRRI Rice Knowledge Bank (2024)

Constraints

• Limited access to finance for mill modernization, especially for small and medium operators.

• Weak incentives for quality-based procurement upstream, reducing pressure to improve post-harvest handling.

7.6.4. Transport Infrastructure and Modal Characteristics

Transport logistics for cereals are dominated by road-based systems, with limited use of rail or waterways for bulk movement.

Current situation

• **Road transport accounts for over 80–85%** of domestic cereal movement, primarily via trucks and pickups carrying bagged grain.

• Inland waterways are used selectively for public procurement and long-distance movement but remain underutilized.

• Rail transport plays a marginal role due to limited bulk-handling compatibility and scheduling constraints.

Table 42: Transport Cost Comparison

Transport Type	Cost (BDT/MT-km)	Quality Loss (%/100km)	Speed (km/hr)	Weather Dependency	Infrastructure Requirement
Open Truck	3.5-4.5	0.8-1.2	40-50	Moderate (rain)	Roads
Covered Truck	4.5-6.0	0.3-0.5	45-55	Low	Roads
Bulk Truck	3.0-4.0	0.5-0.8	40-50	Moderate	Roads + loading equipment
River Barge	1.5-2.5	0.2-0.4	8-12	High (season)	River ports, waterways
Rail Wagon	2.0-3.0	0.3-0.5	30-40	Low	Rail network, sidings
Small Boat	2.5-3.5	0.5-0.8	6-10	High	River access

Note: River transport is cost-effective but seasonal; the monsoon enables waterways, dry season reduces capacity
Sources: Industry estimates; FPMU Bangladesh (2024)

Key constraints

• High dependence on bagged transport increases handling losses, labor costs, and turnaround times.

• Seasonal congestion during peak harvests and import arrivals disrupts timely movement.

• Limited bulk handling infrastructure (conveyors, silos, covered loading bays) restricts efficiency gains.

7.6.5. Import and Port-Centric Logistics (Wheat and Maize)

For wheat and a portion of maize, logistics performance is closely tied to port infrastructure and bulk handling capacity.

What exists

• Imports are concentrated through **Chattogram Port,** with some use of Mongla Port.

• Grain is typically unloaded using a combination of bulk and bagged systems, depending on vessel type and importer capacity.

• Public and private silos receive a portion of imports, especially for government stocks.

What is missing

• Dedicated, modern **bulk grain terminals** with high-capacity unloaders and direct conveyor links to silos.

• Sufficient port-adjacent storage to reduce demurrage and congestion.

• Efficient multimodal links from ports to inland consumption centers.

Implications: Port congestion, vessel delays, and handling inefficiencies increase landed costs and expose the cereal system to **global price volatility and supply disruptions,** particularly during periods of international market stress.

7.6.6. System-Level Capacity Gaps and Misalignment

Across the cereals sub-sector, infrastructure investments remain **misaligned with loss hotspots:**

• Drying and first-mile handling, where quality losses originate, receive minimal investment.

• Storage and milling upgrades lag behind production growth.

• Import logistics focus on throughput rather than resilience and cost efficiency.

As a result, cereals experience moderate percentage losses but very large absolute economic losses, given the scale of production and consumption.

7.7. International Trade Dimensions and Import Dependencies

7.7.1. Import Composition, Volumes, and Sourcing Patterns

Bangladesh's cereal sector is characterized by overwhelming import dependence rather than export potential. Bangladesh imports **approximately 85-90% of its wheat consumption** (annual demand 7.0-7.5 million tonnes) and **significant maize volumes for the livestock feed industry,** while maintaining **self-sufficiency in rice with occasional strategic imports** during production shortfalls.

Wheat Imports

In fiscal year 2023-24, wheat imports exceeded 6.8 million metric tons (MT), representing a five-year peak, valued at approximately $1.5-1.7 billion at prevailing international prices of $227-240 per tonne (Ministry of Food, 2024). This import volume reflects Bangladesh's structural wheat deficit; domestic production of approximately 1.1 million MT covers only 15% of total demand, with the remainder met through government procurement and private sector imports.

Following India's wheat export ban in May 2022, Bangladesh diversified sourcing significantly. Russia emerged as the dominant supplier, accounting for approximately 50% of total wheat imports (~3.4 million MT), with the Government of Bangladesh procuring 850,000 tonnes directly from Russian suppliers (Ministry of Food, 2024). Ukraine, despite ongoing conflict, maintained wheat exports to Bangladesh through Black Sea grain corridor arrangements, supplying an estimated 10-15% of imports. Other major sources include Canada, Australia, Romania, Bulgaria, and Uruguay, while the United States re-entered the market in 2023-24 after a hiatus, exporting 93,000 MT.

This diversification was necessitated by India's abrupt export prohibition, which previously supplied 62.3% of Bangladesh's wheat imports in FY2021-22, followed by Canada (13.3%), Ukraine (8.7%), Australia (7.6%), Argentina (4.7%), and Russia (2.1%). The shift toward Russian and Ukrainian wheat, despite geopolitical risks, reflects price competitiveness and bilateral payment arrangements that mitigate foreign exchange pressures.

Maize Imports

Bangladesh imports maize primarily for poultry and cattle feed, with Brazil dominating at 80% of import volumes, followed by India (5.9%) and Myanmar (5.4%). Total maize import volumes fluctuate based on domestic harvest performance—in years with strong domestic production (3.8-4.0 million MT), imports decline to 200,000-400,000 MT, while weaker harvests necessitate imports of 600,000-800,000 MT. Import prices average $280-320 per tonne CIF Chattogram Port.

Rice Imports

Rice imports are episodic and politically sensitive, activated only during production shortfalls or price stabilization needs. Bangladesh imported minimal rice volumes in FY2023-24 due to adequate domestic production, though global price volatility (exacerbated by India's non-basmati rice export ban in 2022-23) constrained import options when needed. Historical sources include India (when permitted), Thailand, Vietnam, Myanmar, and Pakistan, with imports typically comprising 0.5-2% of total consumption.

7.7.2. International Logistics Infrastructure and Port Operations

Cereal imports flow through Bangladesh's two main seaports: Chattogram Port (handling 85-90% of grain imports) and Mongla Port (10-15%), with minimal volumes through Payra Port (operational but limited grain-handling capacity).

Chattogram Port operates dedicated grain silos and bulk handling facilities, though capacity constraints necessitate the use of bagged imports for significant portions. The Bangladesh Food and Grain Council coordinates government wheat procurement and distribution through the public procurement system. Private sector imports are cleared through Chattogram Customs House, with imported grains either moving directly to flour mills or entering private warehouse systems.

Transit times for wheat shipments average: 15-20 days from Black Sea ports (Constanta, Odessa via alternative routes, Novorossiysk), 25-30 days from North American ports (Vancouver, US Gulf), 12-18 days from Australian ports (Fremantle, Adelaide), and 18-25 days from South American ports (Santos, Buenos Aires). Freight costs range from $25 to $45 per tonne depending on origin, charter market conditions, and seasonal demand.

International shipping lines operating bulk carriers for grain include Cargill Ocean Transportation, Louis Dreyfus Armateurs, Oldendorff Carriers, and regional operators. These companies provide Panamax and Handymax vessels for bulk grain shipment, often under long-term contracts with major trading houses.

Major international grain traders active in Bangladesh wheat procurement include Cargill, Louis Dreyfus Company (LDC), Bunge, Glencore Agriculture, and regional traders such as Olam International and Adani Wilmar. These companies coordinate origin procurement, vessel chartering, cargo insurance, and destination logistics, earning margins of $10-20 per tonne on typical transactions.

Within Bangladesh, wheat distribution involves extensive networks of flour mills (both large industrial mills and thousands of small atta/maida mills), government food warehouses operated by the Directorate General of Food, and private grain traders and wholesalers. The public food distribution system maintains strategic grain reserves of approximately 2.4 million MT capacity (expanding to 3 million MT by 2025) across 1,800+ government warehouses and 18 modern silos.

7.7.3. Customs, Quarantine, and Quality Assurance Systems

Wheat and maize imports face less stringent phytosanitary scrutiny than horticultural or livestock products, yet several regulatory checkpoints govern quality and safety.

Customs clearance at Chattogram Port is

managed by Chattogram Customs House under the National Board of Revenue (NBR). Standard documentation includes a bill of lading, commercial invoice, packing list (or weight certificate for bulk), certificate of origin, phytosanitary certificate from exporting country (certifying freedom from quarantine pests), and letter of credit or payment documentation.

The **Plant Quarantine Wing** inspects grain shipments to verify freedom from prohibited pests, particularly khapra beetle (Trogoderma granarium), various weevil species, and other storage pests that could establish in Bangladesh. Fumigation is required if live infestation is detected, conducted with phosphine or methyl bromide at port fumigation facilities, adding 5-7 days to clearance times and costs of $800-1,500 per container or proportional charges for bulk fumigation.

Quality parameters monitored by **Bangladesh Standards and Testing Institution (BSTI)** include moisture content (maximum 14% for safe storage), foreign matter content (typically <2%), damaged kernels, and mycotoxin levels (particularly aflatoxin for maize, vomitoxin/DON for wheat). While BSTI conducts periodic sampling, comprehensive testing is not routine for bulk commercial imports, creating potential food safety risks that informal quality control by millers and traders partially addresses through visual and tactile inspection.

The Ministry of Food's Directorate General of Food maintains additional quality specifications for government procurement, including minimum protein content (11.5% for bread wheat), falling number (minimum 250 seconds), and test weight parameters, with accredited surveyors conducting pre-shipment and discharge inspections.

7.7.4. Border Trade and Regional Grain Flows

Cereal border trade remains minimal compared to horticultural products, reflecting transportation economics (low value-to-weight ratio makes long-distance small-volume trade uneconomical) and government sensitivity around grain supplies.

India-Bangladesh border areas see modest rice and pulse flows through border haats, primarily serving local consumption rather than commercial volumes. During periods of price differentials, informal rice movements occur, though India's export bans and Bangladesh's own rice export prohibitions limit scale.

Myanmar-Bangladesh border trade includes rice exports from Myanmar to Bangladesh (particularly during Myanmar surplus years), with some maize flows. Myanmar rice traditionally enters through Sittwe-Teknaf waterway crossings, though volumes are undocumented and variable, estimated at 5,000-20,000 tonnes annually depending on relative prices and harvest outcomes.

7.7.5. International Investment and Infrastructure Projects

Given the cereals sector's import-dependent nature, **international investments focus on infrastructure for import facilitation, storage**

capacity enhancement, and domestic production efficiency rather than export development.

The **Asian Development Bank's** National Logistics Policy implementation support includes components addressing port efficiency, silo capacity expansion, and multimodal connectivity that facilitate grain imports. ADB's cumulative Bangladesh portfolio includes infrastructure loans supporting Chattogram Port expansion and logistics corridor development.

The **World Bank,** through its Bangladesh Development Update and sectoral programs, has identified food security and grain storage infrastructure as priorities, supporting projects for strategic grain reserve capacity expansion and warehouse modernization, though specific project-level investments in cereal infrastructure are integrated within broader agricultural and rural development portfolios.

The **United States Department of Agriculture (USDA),** beyond export market development for US wheat (which faces price competitiveness challenges against Black Sea origins), provides technical assistance on grain quality standards, mycotoxin management, and food safety systems through USDA Foreign Agricultural Service programs.

Japanese Official Development Assistance (ODA) through JICA has supported food security programming, including grain storage projects, though recent JICA focus has shifted toward infrastructure (transport, energy) and disaster resilience rather than agricultural storage systems.

The government's warehouse expansion program, financed through domestic allocations and development partner budget support, aims to reach 3 million MT government storage capacity by 2025-26, reducing dependence on ad-hoc private storage and improving price stabilization capacity during import surges or domestic harvest fluctuations.

7.8. Strategic Analysis & Way Forward – Cereals Sub-Sector

Bangladesh’s cereals system, anchored by rice, wheat, and maize, is central to national food security, price stability, and macroeconomic resilience. While production performance has been relatively strong, particularly for rice and maize, the system remains structurally vulnerable due to **high post-harvest losses, import dependence, and logistics inefficiencies.** These challenges increasingly shape food availability and inflation dynamics more than yield constraints.

This section synthesizes cumulative economic losses, strategic strengths and risks, and priority investment and policy pathways to transform the cereals value chain from a volume-driven but loss-prone system into a value-retentive and resilient food logistics network.

7.8.1. Cumulative Loss and Economic Impact

Import Dependence and Exposure: Bangladesh’s cereals balance reveals sharply differentiated risk profiles:

• **Wheat:** Highly import-dependent, with **85–86% of annual consumption (6–7 million MT)** sourced from global markets, costing **USD 2.0–2.5 billion annually.** This exposes the country to global price volatility, freight shocks, and geopolitical disruptions.

• **Rice:** Largely self-sufficient, with imports limited to deficit years and exports confined mainly to aromatic varieties. However, domestic inefficiencies generate large internal losses.

• **Maize:** Rapidly rising import dependency, increasing from **150,000 MT in 2019 to ~2.4 million MT in 2023–24,** driven by expansion of the feed industry.

Logistics bottlenecks, especially port congestion at Chattogram, limited bulk grain handling capacity, and high demurrage, add **USD 5–10/MT** to import costs during peak periods. Import logistics costs (USD 60–90/MT), combined with currency depreciation, amplify inflationary pressure across the food system.

National Post-Harvest Losses: Post-harvest losses represent the largest avoidable economic drain in the cereals sector:

• **Total annual cereal losses** are estimated at **6.0–8.1 million MT**, valued at **USD 2.1–2.8 billion.**

• This loss value exceeds the total value of rice imports in most deficit years.

• A **30% reduction in losses** could save **USD 630–850 million annually** and provide cereals sufficient to feed **15–20 million people**, without expanding cultivated area.

Loss Concentration by Stage: Losses are highly concentrated in a few stages:

• **On-farm drying:** 1.5–2.8%

• **Farm-level storage (3–6 months):** 1.5–7.0%

• **Milling/processing:** 2.5–5.5%

Together, these stages account for **60–70% of total system losses,** indicating that early-stage, relatively low-cost interventions offer the highest returns.

7.8.2. SWOT Analysis

Element	Rice	Maize	Wheat
Strengths	Near self-sufficiency; three-season cultivation; strong research base (BRRI); aromatic rice export niche	High yield potential; strong industrial demand; clustered production; efficient feed-mill linkages	Established import channels; rabi-season crop; lower monsoon exposure
Weaknesses	High post-harvest losses (15–20%); traditional milling dominance; weather-dependent drying	Rising import dependence (35–40%); limited domestic processing diversity	Extreme import dependence (≈85%); stagnant production; disease risks (wheat blast)
Opportunities	Mechanical drying; modern mill expansion; value-added products; selective export growth	Feed sector growth, diversification from rice, and yield gap closure	Import substitution through winter intensification; blast-resistant varieties
Threats	Climate shocks (floods, salinity); labor shortages; price volatility	Global price volatility; pest pressure (FAW); land competition	Geopolitical disruptions, currency depreciation, and global supply shocks

7.8.3. Investment and Policy Implications

Transforming the cereals sector requires prioritizing interventions by economic return, not just by percentage loss reduction. Evidence shows that preventing irreversible quality loss at early stages delivers the highest payoff, while downstream interventions alone have limited impact.

Strategic Priorities

Key priority investment areas are:

A. Mechanical Drying Infrastructure (Highest ROI)

- Critical for rice and maize during peak harvests.
- Investment of **USD 500–800 million** could reduce system losses by **1.5–2.5 percentage points.**
- Community-based and mill-linked dryers should be prioritized.

B. Modern Rice Milling Expansion

- Replacing traditional mills with semi-automatic and automatic systems.
- **USD 300–500 million** investment could reduce milling losses by **40–50%** and improve export-grade quality.

C. Storage Modernization

- Expansion of silos and pest-controlled warehouses for rice and wheat.
- Hermetic storage at farm level offers immediate, low-cost impact.

D. Import and Bulk Handling Logistics

- Dedicated bulk grain terminals, conveyors, and port-adjacent silos.
- Reduces demurrage, handling loss, and landed cost volatility.

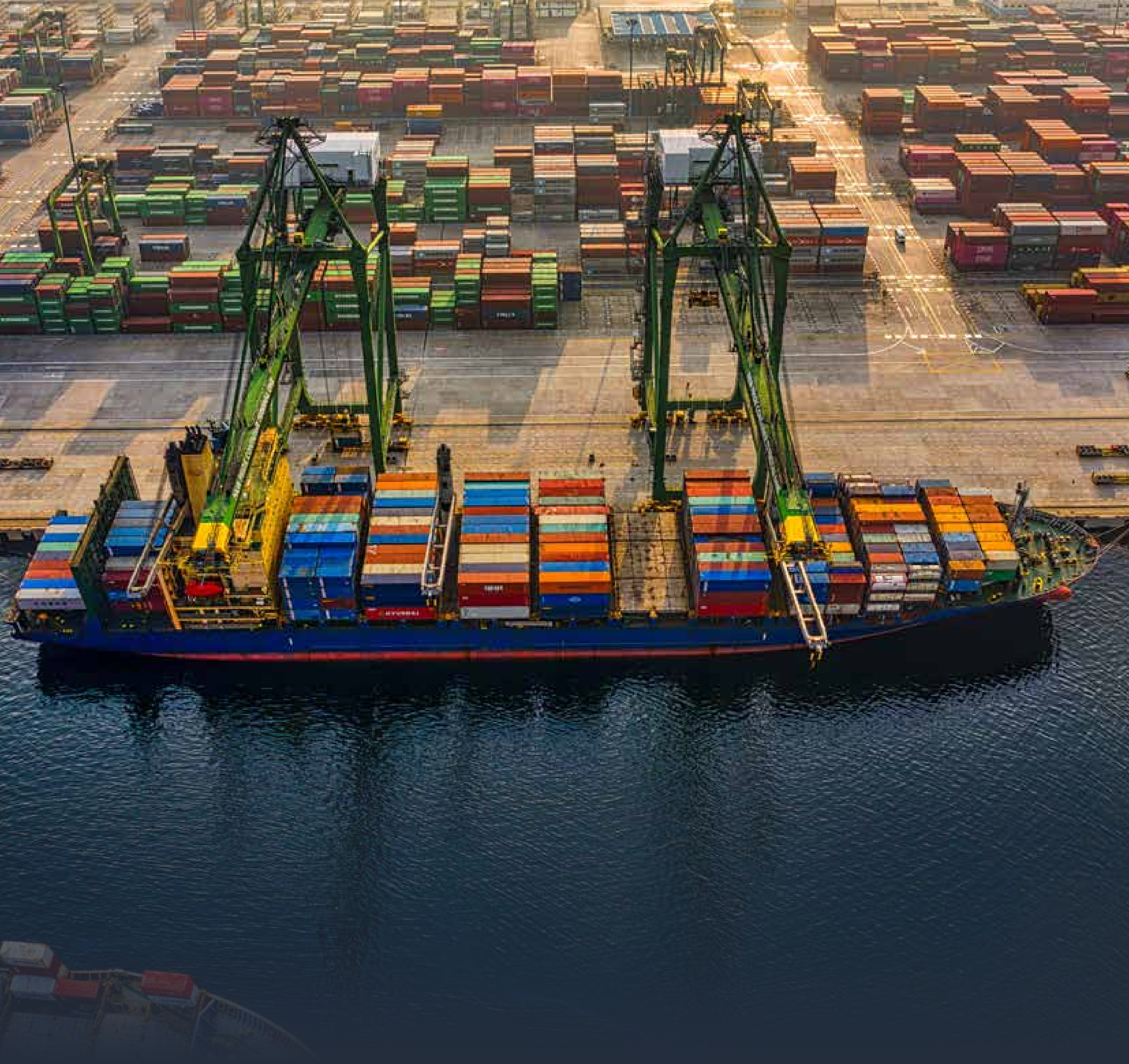
5. Quality Systems and Market Reform

- Expansion of grain testing labs and enforcement of grading standards.
- Enables quality-based pricing and faster price transmission.

Table 43: Summary of Priority Interventions and Delivery Framework

Priority Area	Key Actions	Commodity Focus	Primary Responsibility	Delivery Model
1. First-mile drying	Mechanical & community dryers	All cereals	MoA, Private mills	PPP, private O&M
2. Farm storage	Hermetic bags, metal silos	All cereals	MoA, NGOs	Subsidy + market
3. Milling modern-ization	Automatic/semi-auto mills	Rice	Private sector	Credit & tax incentives
4. Bulk storage & silos	Silo expansion	Rice, Wheat	Ministry of Food	Public + PPP
5. Port grain handling	Bulk terminals, conveyors	Wheat, Maize	Port Authority	Public invest-ment
6. Quality systems	Testing labs, grading	All cereals	DAM, BSTI	Public-led
7. Farmer capacity	PHL training	All cereals	DAE	Public extension

A coordinated strategy, combining **mechanical drying, modern milling, storage upgrades, and import logistics reform,** could convert annual losses into strategic grain reserves, reduce inflation volatility, and strengthen resilience against global supply shocks. With total investment needs estimated at **USD 2.0–3.0 billion,** roughly equivalent to one year of current losses, the cereals sub-sector offers one of the highest-return transformation opportunities within Bangladesh’s agri-food system.



08

Market Entry Points and Investment Opportunities for International Companies

8.1 Commercial Opportunity Landscape

8.1.1 Market Scale and Growth Trajectory

The agro-logistics sector in Bangladesh is estimated at around USD 10.5 billion (BDT 1,282 billion), representing 21.4% of the nation's agricultural GDP. This figure underscores how inefficient logistics, such as post-harvest and cold-chain losses, significantly reduce rural incomes and overall national value addition.

Post-harvest losses are particularly high in Bangladesh, especially for perishable goods: each year, 20%–44% of fruits and vegetables are lost, **costing the economy about USD 2.4 to 2.5 billion annually** due to the lack of adequate cold chain and handling facilities. Multiple industry and government studies confirm these findings.

Cold storage capacity is currently about 2.4 million metric tons, much lower than the estimated demand of 4.5 million metric tons. This shortfall, combined with inefficiency, leads to significant spoilage and waste, especially for perishable items other than potatoes.

Table 43: Total Agro-Logistics Market Size (FY2023-24)

Subsector	Market Share (%)	Value (USD)
Livestock (meat & dairy)	46.7%	4.9 billion
Vegetables	18.87%	2.0 billion
Fish	13.2%	1.4 billion
Fruits	9.8%	1.0 billion
Cereals	7.2%	756 million
Poultry/Eggs	4.2%	441 million
TOTAL	**100%**	**10.5 billion**

Investment Gap: An estimated **financing gap of USD 2.0–3.5 billion** exists in cold chain, first-mile infrastructure, and processing units, presenting both immediate and long-term investment opportunities.

Growth Dynamics:

• **Anticipated 8%-12% per annum growth,** based on urbanization, increasing middle-class consumption (projected to be USD 100+ billion / year of the food market in 2030), and export preparedness needs.

• The growth tailwinds are an increase in **demand for processed foods** (it is expected to increase from approximately USD 5.8 bn by 2030 to approximately USD 4.8 bn by 2025).

8.1.2 Which Problems Can Be Solved Commercially?

PRIORITY A: First-Mile Quality Loss (Highest ROI)

In Bangladesh, 60%-70% of overall post-harvest losses are at the farm level and at early stages of aggregation because of ineffective sorting, drying, transport, and cold chain breakage.

Suggested business solutions and market opportunities:

1. Mechanical Drying Systems

Market Opportunity: USD 500- 800 million on the drying of rice and maize, which are more important in areas where ambient drying is the

current cause of quality decline.
Technology Advantage: The proven technology Ventilex and Cimbria automated moisture control dryers, particularly in the humid tropical environment.

Entry Strategy: Dealer network + after-sales service centers in Bogura, Dinajpur, Rangpur; financing partnerships with IDLC, Lanka Bangla, etc.

2. Village Milk Chilling Centers (VMCCs)

Market Opportunity: USD 200-350 million market of small to medium scale dairy chilling stations; less than 10 percent coverage.

Technology Advantage: Solar-powered systems are gridless and green, enabling mobility as well as climate-adaptive practices.

Business Model: PPP with processor off-take agreements (Milk Vita, BRAC Aarong partnerships)

3. Non-Reefer Insulated Transport Solutions

Market Opportunity: USD 150-250 million opportunity of insulated packaging and vans, which are of lower capex; northern milk belts to Dhaka and shrimp corridors to processing centers, specifically.

Entry Strategy: Partner with logistics companies (Transmove, Shajgoj Logistics)

PRIORITY B - Cold Chain Infrastructure

Approximately, less than 10% of perishables are given the appropriate cold chain treatment; most perishables still move through non-reefer means.

Significant project activities and investment opportunity:

1. Multi-Commodity Cold Storage

Investment Opportunity: Investment USD 300-500 million in 500,000-750,000MT regional hubs in Rajshahi, Jashore, Khulna, and Gazipur. The Dutch expertise (e.g. CO2/NH3 systems) may be used to reduce the oil expenses and make the refrigeration system much more reliable to a significant extent.

Entry Strategy: Joint venturing with local construction companies (Mir Group, Shams Group); Operation & Management contracts for government cold chain projects.

2. Packhouse cold room integration

Investment Opportunity: USD 200-300 million to build around 50-75 grading, packaging, pre-cooling, and phytosanitary processing facilities – to be export-ready.

PRIORITY C: Processing and Value Addition

Only 12% of horticulture and 10-15% of poultry output is processed, leaving surpluses and gluts that depress farmgate prices.

Target Value Chains:

1. Fruit Pulp & Juice Processing: USD 100-150 million approximately.

2. Modern Rice Milling: USD 300-500 million to replace legacy Engleberg/Rice mills and reduce broken rice percentages.

3. Meat Processing & By-Product Utilization: USD 150-250 million, with high value in halal export markets and biogas opportunities from slaughterhouse residues.

8.2 Scalable Business Models by Timeline

Investment opportunities are organized by implementation timeline, capital requirements, and risk-return profiles to enable strategic prioritization.

SHORT-TERM SOLUTIONS (1-2 years, Lower CAPEX, Rapid Deployment)

Solution	Investment	Expected ROI	Target	Implementation
Returnable Plastic Crate Leasing	USD 5-10M	18-25% IRR	Horticulture traders	Deposit system; pilot in Bogura, Jashore
Mobile Pre-Cooling Units	USD 3-8M	20-28% IRR	Mango, tomato hotspots	Service-based pricing; contract with exporters
Insulated Milk Cans + Solar VMCCs	USD 10-20M	15-22% IRR	Northern dairy belt	Processor-backed contracts (Milk Vita, BRAC)
Hermetic Storage Bags (Cereals)	USD 15-25M	25-35% IRR	Rice, maize smallholders	Cooperative bulk purchase; microfinance-linked
Live-Fish Aerated Transport	USD 5-12M	22-30% IRR	Tilapia, pangasius farmers	Trader equipment leasing; quality premium pricing

MEDIUM-TERM SOLUTIONS (2-4 years, Moderate CAPEX)

Solution	Investment	Expected ROI	Target	Implementation
Regional Multi-Commodity Cold Rooms	USD 50-100M	12-18% IRR	Wholesale markets	PPP with city corporations; rental revenue
Integrated Packhouses (Horticulture)	USD 30-60M	14-20% IRR	Export-oriented mango, vegetables	Private investment with export off-take
Feed Mill-Linked Maize Silos	USD 40-80M	13-19% IRR	Commercial maize farmers	Contract farming with poultry integrators
Modern Rice Mill Retrofits	USD 80-150M	16-24% IRR	Medium-scale millers	Concessional credit + tax incentives
Community Mechanical Dryers	USD 60-120M	15-22% IRR	Rice, maize clusters	Service cooperatives; fee-per-kg drying

LONG-TERM SOLUTIONS (4-7 years, High CAPEX, Systemic Transformation)

Solution	Investment	Expected ROI	Target	Implementation
Dedicated Bulk Grain Terminals (Ports)	USD 150-300M	10-15% IRR	Wheat, maize imports	PPP with port authority; demurrage reduction
Export-Grade Halal Meat Processing	USD 100-200M	12-18% IRR	Beef, goat for Middle East	FDI + local partnership; WOAH certification

Solution	Investment	Expected ROI	Target	Implementation
Modern Terminal Wholesale Markets	USD 200-400M	11-17% IRR	Dhaka, Chatto-gram, Rajshahi	Municipal bonds + private concessions
Integrated Dairy Processing Hubs	USD 120-250M	13-19% IRR	UHT milk, cheese, yogurt	JV with Milk Vita, PRAN; branded product margins
Cold Chain Logistics Network	USD 100-180M	14-20% IRR	Cross-sector perishables	3PL service provider model; contract logistics

8.3 Access to Finance: Current Mechanisms and Gaps

8.3.1 Existing Financial Instruments

Bangladesh's agriculture and agro-processing sectors. While a range of financial instruments exists, from commercial bank loans and SME refinancing schemes to microfinance, equity investment, and development finance, their structure, scale, and eligibility requirements vary significantly. As a result, different actors across the value chain experience uneven access to capital.

Large agribusinesses and infrastructure projects are relatively well served by commercial and development finance, whereas smallholders and SMEs, particularly those engaged in logistics, storage, ripening, and value addition, often face barriers related to collateral requirements, high interest rates, bureaucratic procedures, or insufficient loan sizes.

Table 44: Existing Financial Instrumentst

Instrument	Target Borrowers	Loan Size	Interest Rate	Collateral	Accessibility
Commercial Bank Term Loans	Large agribusi-nesses	> USD 4.5M	10-13%	Land, factory assets	Limited to established players
SME Loans (BB Refinancing)	SME logistics providers	USD 90K-900K	USD 90K-900K	Business assets, partial land	Moderate; bureaucratic delays
Microfinance	Smallholder farmers	USD 450-4,500	12-18%	Group guaran-tee, no land	High reach but insufficient for equipment
Agro-Pro-cessing Policy 2022 Incentives	Food process-ing units	Capital support: 50% up to USD 4.5M	5% subsidy for 5 years	Plant, machinery	Underutilized; awareness gap
Equity Investment (VC)	Agri-tech startups	USD 100K-5M	Equity dilution (15-40%)	No collateral; valuation-based	Nascent; limited sector-specific funds

Instrument	Target Borrowers	Loan Size	Interest Rate	Collateral	Accessibility
Develop-ment Finance (IFC, ADB)	Infrastructure PPPs	USD 10M-100M+	5-8% (conces-sional)	Government guarantee, project assets	Lengthy approval; suited for mega-projects

8.3.2 The "Missing Middle" Problem

The most acute financing gap exists for mid-sized agro-logistics investments (USD 500K-5M)—precisely the segment where certain international players such as Dutch SMEs and technology providers operate. This "missing middle" is characterized by:

• Too large for microfinance (which caps at ~USD 5,000)

• Too small or too risky for commercial banks (which prefer loans >USD 4.5M with land collateral)

• Incompatible with venture capital (which seeks 10x returns and digital scalability)

8.3.3 Mitigation Strategies and Access Pathways

• **Blended finance and risk-sharing facilities** have emerged as a promising solution to the financing gap for mid-sized agro-logistics investments. **Development finance institutions, such as IFAD, IFC, and EKN-backed funds,** play a critical role by providing subordinated debt or guarantees that act as first-loss capital.

For example, a typical structure might involve a development finance institution taking on 20% of the first-loss, while commercial banks provide the remaining 80% as senior debt. This arrangement significantly reduces the risk for banks and enables them to lend to smaller agro-logistics companies. Dutch entities like RVO and FMO have developed partnership vehicles specifically designed to support Dutch exporters and investors entering markets such as Bangladesh.

• **Equipment leasing and asset-backed financing** offer another pathway for agro-logistics companies to access capital. This model targets **assets such as cold storage units, reefer trucks, mechanical dryers, and packhouse lines.** In practice, **international companies** such as Dutch equipment manufacturer partners with a local leasing company and an off-taker, such as a processor or exporter, to form a tripartite arrangement. The equipment itself serves as collateral, and revenue assignments from service contracts further secure the deal. **Financial institutions** like IDLC Finance and Lanka Bangla Finance already offer equipment leasing solutions and present opportunities to develop sector-specific products for agro-logistics.

• **Invoice discounting and supply chain finance** address the need for working capital among traders, aggregators, and logistics service providers who have confirmed purchase orders. **Fintech platforms,** including ShopUp and iFarmer, facilitate short-term credit by discounting invoices issued by major buyers such as Pran, ACI, and Meena Bazar. **International companies** can capitalize on this opportunity by offering white-label supply chain finance technology and forming partnerships with local banks to streamline access to credit for businesses in the agro-logistics sector.

• **Green and climate finance** represent an increasingly attractive option for investments in sustainable agro-logistics infrastructure. This **financing supports projects** such as solar-powered VMCCs, energy-efficient cold rooms, and biogas production from slaughter waste. **Funding sources include** the Green Climate Fund, Nordic Development Fund, KfW, and EIB, all offering concessional rates, typically between 3% and 6%, with extended tenures of 10 to 15 years and no land collateral requirements. Dutch companies are well-positioned to benefit from these initiatives, leveraging the Netherlands' climate finance commitments and exporting clean energy technologies to emerging markets.

8.4 Market Entry Points for International Companies

8.4.1 Technology and Equipment Suppliers

A. Cold Chain and Refrigeration Technology

International companies such as Vezet Coldstores, Haag Industrial Refrigeration, and Equans (ENGIE) have significant opportunities in Bangladesh's cold chain sector. The market is particularly promising for firms specializing in the design, construction, and operation of cold storage facilities, especially those utilizing ammonia or CO_2-based natural refrigerant systems to comply with BNCP standards.

A strategic approach to market entry involves forming joint ventures with established local construction firms like Mir Group and Shams Group, as well as securing operations and maintenance contracts for government-led cold chain initiatives. Notably, the Ministry of Agriculture has outlined plans for 25 new multi-commodity cold storage facilities, representing substantial potential projects for international technology and equipment suppliers.

B. Grain Handling and Drying Systems

Companies such as Cimbria, Ventilex, and AGI (formerly Scandura) have significant market opportunities in Bangladesh for turnkey mechanical dryers, including flatbed, LSU, and continuous flow systems, for rice and maize, as well as hermetic storage silos.

A recommended market entry strategy involves building a robust dealer network and establishing after-sales service centers in key agricultural regions like Bogura, Dinajpur, and Rangpur, complemented by financing partnerships with institutions such as IDLC and Lanka Bangla. These companies can differentiate themselves by emphasizing energy efficiency, an important factor given Bangladesh's high-power costs, and by offering automated moisture control features in their solutions.

C. Packaging and Handling Systems

Companies such as BEUMER Group, Teepack (specializing in packaging machinery), and Schoeller Allibert (known for returnable plastic crates, or RPCs) have strong market prospects in Bangladesh's agro-logistics sector. There is a significant demand for returnable plastic crates, with an estimated need of 200,000 to 300,000 units, as well as for automated sorting and grading lines in packhouses.

A recommended strategy for these firms is to adopt a leasing model instead of relying solely on outright sales, while also forming partnerships with logistics companies like Transmove and Shajgoj Logistics to enhance market penetration and operational efficiency.

D. Dairy and Food Processing Equipment

Companies, including Tetra Pak (Dutch-Swedish), Friesland Campina Technical Services, and Vreugdenhil Dairy Foods, have notable opportunities in Bangladesh's dairy and food processing sector. The market is particularly attractive for supplying UHT milk processing lines, cheese and yogurt pilot plants, and aseptic packaging solutions for products like mango pulp.

A recommended approach for entering this market is to form technical partnerships with established local firms such as Milk Vita, Pran-RFL, and Akij Food & Beverage, implementing a train-and-transfer model to enhance local capabilities and ensure technology adoption.

8.4.2 Logistics Service Providers and System Integrators

A. Cold Chain 3PL (Third-Party Logistics)

The cold chain third-party logistics (3PL) business model in Bangladesh centers around the provision of temperature-controlled warehousing, a dedicated reefer vehicle fleet, and last-mile distribution services targeting modern retail, e-commerce, and export sectors. Establishing a regional hub in Dhaka or Chattogram with a 5,000 metric ton storage capacity and a 20-vehicle fleet typically requires an investment of USD 10–25 million. Revenue is generated through storage fees, ranging from BDT 8–12 per kilogram per month, transportation charges at BDT 18–25 per ton-kilometer, and value-added services, such as sorting and repacking.

For International companies, such as Dutch companies seeking market entry, strategies include acquiring or partnering with emerging local logistics providers like Transmove and Paragon Logistics, as well as implementing franchise models to transfer operational expertise.

B. Agri-Tech Platform Integration

Digital marketplaces and logistics aggregation platforms, such as iFarmer and AgroShop24, depend on highly efficient last-mile fulfillment to succeed. Dutch technology providers offer valuable solutions in this context, including advanced route optimization software (for example, Quintiq by Dassault Systèmes), IoT-based cold chain monitoring systems, and blockchain-enabled traceability features. Integrating these technologies and launching pilot deployments typically requires an investment of USD 2–8 million. The primary revenue streams for these platforms include SaaS subscription fees, transaction-based commissions, and offering data analytics services to buyers.

8.5 Risk Assessment and Mitigation for International Investors

Risk Category	Specific Risks	Mitigation Strategies
Regulatory and Policy Risk	Import duty/VAT uncertainty; delayed permits; inconsistent enforcement of food safety standards	Early engagement with BIDA, NBR, BFSA for policy clarification; Build relationships with sector associations (BAPA, BFFEA); Structure projects under SEZ or Hi-Tech Park regimes
Demand and Offtake Risk	Seasonal gluts; price volatility; buyers defaulting on contracts	Secure long-term off-take agreements (min. 3-year) with processors, exporters, modern retail; Diversify commodity mix (multi-product cold storage); Include price floor clauses
Infrastructure Risk	Power outages (avg. 8-12 hours/week in rural areas); poor road connectivity; skilled labor shortage	Invest in backup generators, solar+battery hybrid systems; Cluster facilities near highways, ICDs, export zones; Partner with technical institutes (Bangladesh Agricultural University) for workforce training
Currency Risk	BDT depreciation (avg. 3-5%/year vs. USD); forex restrictions during crises	Hedge forex exposure through forward contracts with commercial banks; Invoice exports in USD to generate hard currency revenue; Maintain working capital in USD via offshore accounts
Climate Risk	Floods, cyclones disrupting transport and production; salinity intrusion in coastal shrimp zones	Invest in climate-resilient infrastructure (elevated platforms, flood-proof cold rooms); Diversify sourcing regions (multiple shrimp zones); Parametric weather insurance for crop-linked investments
Political/Governance Risk	Government turnover affecting policy continuity; corruption in permits/licensing; land ownership disputes	Engage legal due diligence on land titles (especially rural land for warehouses); Build bipartisan relationships; align with multi-year government programs (8th Five-Year Plan); Maintain transparency and anti-corruption compliance

8.6 Success Factors and Critical Enablers

To maximize the probability of commercial success, international companies and investors should prioritize:

1. Local Partnership: Joint ventures with established Bangladeshi firms reduce regulatory friction, provide market intelligence, and build trust with farmers/traders.

2. Pilot-Scale Demonstration: Start with 1-2 small facilities or equipment clusters to prove the technology/model before scaling.

3. Integrated Solutions: Bundle hardware (cold rooms, dryers) with software (traceability, market linkage) and services (aggregation, extension) for higher value capture.

4. Patient Capital: Expect an 18–24-month ramp-up period; early-stage losses are common as supply chains stabilize.
5. ESG and Impact Metrics: Document and market social returns (farmer income increase, women's employment, carbon footprint reduction) to access blended finance and build brand reputation.

6. Government Engagement: Proactive coordination with BIDA, relevant ministries (Ministry of Agriculture, Ministry of Fisheries and Livestock, and Ministry of Food), and EKN to align with national priorities and access incentives.

09

Conclusion and Recommendations

9.1 Conclusion

This Agro-Logistics System Mapping study demonstrates that Bangladesh's food system performance is increasingly constrained not by production shortfalls, but by systemic weaknesses in post-harvest handling, storage, transport, and market integration across horticulture, fisheries, livestock, and cereals. Across all four sub-sectors, losses, quality degradation, and value erosion are concentrated at early stages of the value chain, particularly at the first mile, during aggregation, and at wholesale market interfaces, where infrastructure gaps, informality, and weak coordination persist.

The analysis shows that cumulative post-harvest losses across priority commodities amount to several billion US dollars annually. In **cereals** alone, annual losses of 6–8 million metric tons represent an economic drain of USD 2.1–2.8 billion, exceeding the cost of many food imports. In **fisheries,** losses of 20–25% translate into more than USD 150 million annually, with hilsa and shrimp suffering the highest per-unit value erosion. **Livestock** value chains experience less visible physical loss but significant quality downgrade, live-weight loss, mortality, and price suppression, especially in dairy, red meat, and poultry. **Horticulture** exhibits the highest percentage losses, driven by perishability, lack of cold chain continuity, and congestion in wholesale markets.

A consistent pattern emerges across sectors:

• **First-mile failures,** delayed cooling, inadequate packaging, and poor handling cause irreversible quality damage that cannot be recovered downstream, even where modern processing exists.

• **Intermediary-dominated market structures** prioritize speed over preservation, transferring logistics and quality risks upstream to producers while capturing margins downstream.

• **Infrastructure investments are misaligned with loss hotspots,** with excessive focus on downstream facilities (e.g., shrimp processing plants, large mills) and insufficient attention to farm-level drying, chilling, aggregation, and market infrastructure.

• **Climate stress and seasonality,** heat waves, monsoon flooding, cyclones, and festival-driven demand spikes amplify logistics bottlenecks, especially where systems lack buffering capacity.

• **Weak standards, traceability, and market information systems** constrain quality-based pricing, export readiness, and private investment.

The study finds that reducing post-harvest losses offers the fastest, most cost-effective pathway to improving food availability, stabilizing prices, strengthening farmer incomes, and enhancing resilience, often at far lower cost than expanding production or increasing imports.

9.2 Cross-Sector Strategic Insights

1. Economic returns are highest at the first mile

Low-cost interventions such as immediate icing, mechanical drying, insulated containers, improved packaging, and basic hygiene protocols consistently deliver the highest returns across all sub-sectors by preventing irreversible losses.

2. Value erosion exceeds visible spoilage

Quality downgrades, distress sales, live-weight loss, and price discounts account for a larger share of economic loss than outright physical spoilage, particularly in livestock, fisheries, and horticulture.

3. Cold chain should be strategic, the "Whole Chain" Requirement

Critical mapping of agro-logistics in the major commodities in Bangladesh indicates that technological solutions do not realize strategic success in mitigating losses, but continuity of the chain of operations through seamless whole chain continuity. Evidence in the horticulture and fisheries sectors shows that a disrupted cold chain is practically useless. As an illustration, cooling of products at a packhouse and exposing them to ambient temperatures during transport or at the airport causes instantaneous thermal shock and condensation. This sudden temperature change can easily result in faster decomposition than when the product was never cooled at all, and end-to-end cold chain continuity, such as temperature-controlled airport cargo handling, can be required to minimize quality loss at critical nodes.

4. Market infrastructure is as critical as farm technology

Congested, unhygienic wholesale markets lacking cold storage, drainage, and covered auction areas are significant loss multipliers across various sectors.

5. Policy coherence and coordination matter

Infrastructure investment without complementary reforms in standards, finance, trade policy, and institutional coordination yields limited impact.

Cross-Cutting Insights on International Dimensions

The international integration of Bangladesh's agro-logistics system reveals significant asymmetries across commodity groups. **Fisheries** exhibit the most mature export orientation, with established value chains, specialized infrastructure, and compliance systems aligned with international standards. **Horticulture** demonstrates emerging export potential constrained by logistics gaps, while **livestock** remains overwhelmingly domestic-focused with minimal formal export activity. **Cereals** operate in reverse, characterized by structural import dependence necessitating efficient inbound logistics rather than export facilitation.

Common constraints across export-oriented sectors:

- Inadequate cold chain infrastructure is limiting quality retention and market reach.
- High freight costs (both air and sea) are eroding price competitiveness.
- Compliance costs and technical capacity gaps in meeting evolved SPS standards;
- Limited value addition constrains to commodity-level exports rather than premium processed products; and
- Post-LDC graduation challenges include export subsidy phase-outs and potential tariff increases in current duty-free markets.

Opportunities for enhanced international competitiveness center on:

- Strategic investments in VHT facilities, modern packhouses, and integrated cold chains for enabling access to high-value markets;
- Traceability system implementation for supporting premium positioning; bilateral and regional trade agreements securing market access as LDC preferences erode;
- Private sector-led logistics service provider models for reducing reliance on trader-controlled infrastructure; and
- Coordinated development partner support for addressing infrastructure, compliance capacity, and market intelligence simultaneously rather than in fragmented interventions.

The **border trade dimension, particularly with India,** represents an under-leveraged channel that, if formalized and facilitated through infrastructure investments at Land Customs Stations and expanded border haat networks, could provide incremental export opportunities for smallholder-produced vegetables, fruits, and fish while potentially regularizing informal livestock flows under transparent, humane, and legally compliant frameworks.

9.3 Recommendations

9.3.1 Priority Investment Areas

1. Strengthen First-Mile Handling (Highest Priority, All Sectors)

• Expand farm- and landing-level access to ice, mechanical dryers, insulated crates, and basic pre-cooling.

• Scale farmer and trader training on maturity indexing, hygiene, ice-to-product ratios, and handling protocols.

• Promote low-cost, decentralized technologies (solar dryers, village milk chilling centers, mobile icing units).

2. Modernize Aggregation and Wholesale Markets

• Upgrade major wholesale hubs into functional terminal markets with cold rooms, covered auction platforms, sanitation, drainage, and waste management.

• Introduce designated unloading windows and buffer storage to reduce congestion-driven delays and quality loss.

3. Rational Cold Chain Expansion

• Prioritize multi-commodity cold rooms at aggregation and wholesale nodes rather than isolated downstream facilities.

• Support insulated (non-reefer) transport fleets and leasing models for domestic supply corridors.

• Improve live-animal and live-fish transport systems to reduce mortality and stress losses.

4. Storage and Processing Upgrades Where Economically Justified

• Expand mechanical drying and hermetic storage for cereals.
• Modernize rice milling and encourage by-product utilization.

• Support selective expansion of livestock and fish processing where volumes, standards, and market access justify investment.

5. Decentralized Ripening Infrastructure to Strengthen SME Participation

• Investment in the horticulture value chain should shift toward decentralized infrastructure that enables SMEs to modernize operations.

• Infrastructure should be designed at a scale appropriate for small and medium enterprises, rather than large centralized systems.

• For SMEs handling high-value fruits such as papaya and banana, ethylene generators should be prioritized.

• Portable ethylene generators are highly scalable and allow small aggregators to control ripening effectively.

• Unlike large, fixed industrial ripening chambers, portable systems support cluster-level ripening.

• Controlled ripening reduces physical losses and value erosion compared to traditional chemical-dipping or ambient ripening methods.

9.3.2 Policy and Institutional Actions

Market System Reform

• Promote digital market information and traceability systems to improve price transparency and quality differentiation.

• Expand formal credit and insurance mechanisms to reduce dependence on informal advance credit systems.

Standards, Quality, and Export Readiness

• Strengthen food safety, SPS, and residue testing capacity across fisheries, livestock, and horticulture.

• Prepare for post-LDC trade conditions through improved compliance, certification, and cold handling at ports and airports.

Climate-Resilient Logistics Planning

• Integrate climate risk into agro-logistics planning, including flood-resilient infrastructure, heat-mitigating designs, and contingency transport routes.

• Promote climate-resilient varieties and production systems aligned with logistics capacity.

Data, Monitoring, and Coordination

• Institutionalize regular post-harvest loss measurement and value chain diagnostics.

• Strengthen coordination among agriculture, transport, commerce, local government, and private sector stakeholders.

• Use public-private partnership models to crowd in private investment while ensuring public goods provision.

Bangladesh's transition to a more efficient, resilient, and value-retentive food system depends on shifting the policy and investment lens from production expansion to logistics efficiency and loss reduction. **The evidence across cereals, horticulture, fisheries, and livestock is unequivocal: targeted investments at early stages of the value chain, supported by coherent policy reforms and market modernization,** can unlock substantial economic, nutritional, and environmental gains.

Reducing post-harvest losses by even 25–30% would free food equivalent to feeding millions of people annually, stabilize prices without increasing land or water use, improve farmer incomes, and strengthen resilience against climate and global market shocks. Agro-logistics reform, therefore, should be positioned not as a supporting activity but as a central pillar of Bangladesh's food security, trade competitiveness, and inclusive agricultural growth strategy.

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