The dairy and beef value chain in Bangladesh

Diagnostics, investment models and action plan for development and innovation

Draft Report, May 2019

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Executive summary

The livestock sector in Bangladesh has shown its strong presence with a fast-growing market for meat and dairy products. To provide its 165 million population with sufficient, safe and nutritious food, the government has deployed great efforts in reforming the whole livestock sector, of which dairy and beef sub-sectors have been given particular emphasis. As an agriculture-based country, the majority of the rural households adopt a mixed farming system by cultivating crops and rearing livestock at the same time. Among the animals raised, cattle is considered as the most valuable asset for small-scale farmers in terms of its meat and milk producing functions. However, the bottlenecks existing in cattle rearing as well as along the entire downstream value chain largely constrain rural households to climb out of poverty.

Under this context, the 3ADI+ programme in Bangladesh aims to improve dairy and beef sub-sectors by taking a sustainable food value chain approach. This report is evidence-based which presents a holistic picture of dairy and meat value chains in Bangladesh, incorporating by-products, supporting services and enabling environment. Through identifying key constraints and root causes of value chain performance, the report also designs business models with possible interventions and an action plan to achieve economic, social and environmental sustainability.

The report is mainly divided into five parts:

- Start with an **introduction** about the livestock sub-sector in Bangladesh and its contributions to national economic growth. Particular emphasis will be given on dairy and beef value chains.
- Describe the **methodology** has been adopted to conduct data collection and develop the report.
- Conduct detailed **value chain analysis** on dairy and beef value chain (including by-products) in Bangladesh, with support services and enabling environment included, to understand the performances of these two sub-sectors, as well as the key constraints and challenges to be addressed.
- Analyze the **opportunities for investment** based on the analysis. Business models and system interventions with corresponding investment plan will be designed to tackle the binding constraints for a long-term sustainable development.
- An **action plan** is developed to provide concrete objectives and actions for the programme implementation.

The report will demonstrate a full picture of dairy and beef sub-sectors in Bangladesh and provide practical guidance on programme implementation.

List of Acronyms

BAU	Bangladesh Agriculture University
BDT	Bangladesh Taka
BM	Bengal Meat
BMPCUL	Bangladesh Milk Producers Co-Operative Union Ltd
CAGR	Compound annual growth rate
DAIC	District Artificial Insemination Centre
DLO	District Livestock Office
DLS	Department of Livestock Services
FAO	Food and Agriculture Organization of the United Nations
FY	Fiscal Year
HF	Holstein-Frisian
LME	Liquid Milk Equivalent
MoFL	Ministry of Fisheries and Livestock
MV	Milk Vita
NLDP	National Livestock Development Policy
PPP	Public-Private Partnership
SMEs	Small and Medium-sized Enterprises
TDN	Total Digestible Nutrients
UHT	Ultra High Temperature
UNIDO	United Nations Industrial Development Organization
ULO	Upazila Livestock Office
3ADI+	Accelerator for Agriculture and Agroindustry Development and Innovation

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1. Introduction

1.1 Programme context

The Accelerator for Agriculture and Agroindustry Development and Innovation (3ADI+) is a joint value chain and market systems development programme, spearheaded by the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Industrial Development Organization (UNIDO). 3ADI+ brings the combined capacities of local, national, regional and global actors on analysis, technical assistance, facilitating linkages, policy dialogue, and investment promotion, to develop sustainable value chains in developing countries. Based on pre-defined criteria, the 3ADI+ team selected Bangladesh as one of the pilot countries for program rollout (together with Tanzania and Suriname). At the request of the Government of Bangladesh, the program focused on the livestock sector, and particularly the value chains of dairy, beef and cattle by-products. This choice of value chains is aligned with national development priorities.

In 2018, during the inception phase, each UN organization dedicated an international consultant to analyze the value chains, which involved multiple rounds of fieldwork in Bangladesh. The major work included the design of data collection tools and the implementation of a diagnostic study, with the assistance of a local Bangladeshi consulting firm and four Bangladeshi subject matter expert consultants. From March to December, massive data collection work was conducted across ten selected districts. The districts were selected based on varying development levels and their involvements in dairy and bull-fattening activities. The survey covered all types of stakeholders including:

- Dairy farmers, bull-fattening farmers, milk cooperatives and producer groups
- Milk collectors and village milk collection centers
- Leading dairy firms and SMEs
- Cattle traders
- Butchers and slaughterhouses (both traditional and modern)
- Traditional processors (intermediate processors and sweetmeat makers)
- Retail shops, wet markets and consumers
- Service providers (feed companies, veterinary input suppliers, AI workers)
- DLS and its decentralized offices (DLO and ULO)
- NGOs, specialized associations and other institutions involved in dairy and beef sub-sectors and by-products chain

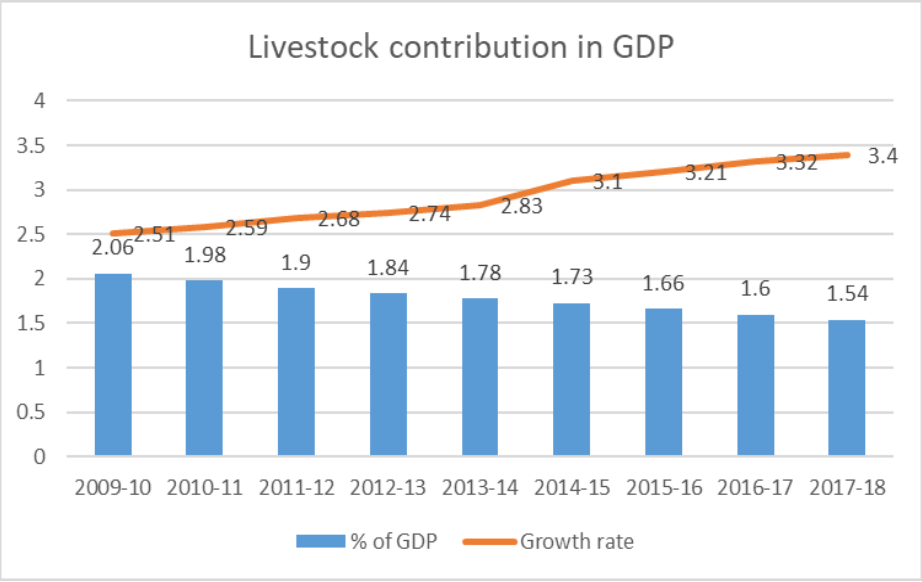
The research findings were used to develop inclusive business models and an action plan for the coordinated upgrading of the value chains. The primary findings of the field research were presented to the Government, in December 2018, at a ceremony at which presided the DG of the Department of Livestock Services, the DG of the Bangladesh Livestock Research Institute, the Representative of the FAO, the UNIDO Country Representative and over 60 participants from the public, private, civil and university sectors. In February 2019, a grant issued by IFAD South-South Cooperation Fund Facility has been given to 3ADI+ Bangladesh for the pilot implementation of a two-year period. The 3ADI+ programme aims to improve the dairy and beef sub-sectors through agriculture and agro-industrial value chain development. By facilitating partnerships and responsible investments, the programme will be built on a participatory basis and contribute to sustainable impacts.

1.2 Country context

Bangladesh is a country with 165 million population and a density of 1115.62 people per square kilometer, ranking 10th in the world[1]. While 24.3% of the population are currently living below the National Poverty Line (2016)[2]. Even though the rate is decreasing, people in Bangladesh are still suffering undernutrition, malnutrition and severe food safety issues. Hence, the Bangladesh government recognizes the crucial role of agriculture, livestock and fisheries in providing the population with essential and nutritious food and generating employment for a huge number of low-income and vulnerable people living in poor and rural areas. According to DLS, the livestock sub-sector provides 20% of the population with direct jobs and 45% with part-time jobs. This is particularly important for unemployed youth and women, as well as landless farmers, to lift themselves out of poverty.

Regarding its contribution to the national economy, the livestock sub-sector accounted for 1.54% of the total GDP in Fiscal Year (FY) 2017-18, slightly decreasing year by year. Even though the contribution seems to be small, the GDP growth rate of livestock has increased from 2.51% to 3.4% from FY 2009 to 2018(see table below) representing its potential in rural development and poverty alleviation.

Figure 1: Livestock contribution in GDP and its growth rate



Source: Livestock Economy at a Glance, DLS[3]

The mixed farming system, by cultivating crops and rearing livestock at the same time, is a common practice in the country, landless farmers have to largely depend on a pure livestock farming system. The livestock sub-sector in Bangladesh includes all types of produce (meat, milk and eggs) and by-products (skins, hides, etc.) from ruminants (cattle, buffalo, sheep and goat) and poultry (chicken and duck). Bangladesh is a country facing great challenges in fighting against malnutrition and undernutrition. With a fast-growing population and increasing

[1] World Population Review (2019), Bangladesh Population 2019. http://worldpopulationreview.com/countries/bangladesh-population/

[2] Asian Development Bank, Poverty in Bangladesh. https://www.adb.org/countries/bangladesh/poverty

[3] DLS, Livestock Economy at a Glance (2017-18), retrieved from http://dls.portal.gov.bd/sites/default/files/files/dls.portal.gov.bd/page/ee5f4621_fa3a_40ac_8bd9_898fb8ee4700/Livestock%20Economy%20at%20a%20glance%20%20%282017-2018%29.pdf

nutrition awareness, the government of Bangladesh is aware of the significance of strengthening livestock development to fulfil the demand.

Among all types of ruminants promoted, cattle is considered as a superior option because of its dual functions: milk and meat. However, the dairy and beef sub-sectors in Bangladesh is characterized by small-scale producers with less than three cattle per household and low productivity. Under this context, 3ADI+ will mainly focus on these two sub-sectors to identify the underlying constraints and seek possible upgrading strategies to improve the performances.

1.3 Report structure

After this introduction, the report will mainly contain four key parts:

The first part introduces the methodology adopted for 3ADI+ preliminary research, including an integrated approach combining FAO and UNIDO's framework and tool in value chain studies, and the methodology for data collection.

The second part describes and summarizes the key findings of the study conducted by the 3ADI+ core team. The findings will draw a whole picture of the dairy and beef value chain in Bangladesh, starting from end-market analysis and national value chain maps, to a comprehensive analysis on core value chain segments, support services, social and natural elements as well as cross-cutting dimensions.

The third part identifies the opportunities to improve current value chains by clearly defining a vision and designing upgrading strategies using business models and system interventions. The upgrading strategies mainly tackle the key constraints identified in the analysis, aiming to achieve the greatest impacts. Meanwhile, an investment plan is developed accordingly based on the proposed interventions.

The fourth part provides a practical guideline for the development of the value chains. An action plan is formed with concrete goals and actions, specific timeline and budget, risk mitigation, and monitoring and evaluation. It clearly indicates the way forward for the 3ADI+ programme in Bangladesh.

2. Methodology

The 3ADI+ programme in Bangladesh applies an integrated approach by combining methodologies of both FAO and UNIDO. The Sustainable Food Value Chain (SFVC) approach of FAO is a systemic analytical framework, taking core and extended value chains, supporting services, social and natural elements as key components to measure, understand and improve the value chain performances. The approach is based on the FAO manual "Developing Sustainable Food Value Chains – Guiding Principles" which has been applied to various projects with its systematic way of thinking and well-tested tools. This approach is combined with UNIDO's Industrial Value Chain Diagnostics Tool, which provides practical guidance on business models development by contributing to economic, social and environmental objectives.

During the inception phase in 2018, this integrated approach was followed and applied by the international team for data collection and report writing. Based on this approach, a full package of questionnaire has been designed and a practical tool has been developed to understand the cost structure and profit margins of various value chain actors and service providers. The application of this approach was initiated with training provided to the national consultants, through learning-by-doing. In such a way, they were able to use the tools for conducting data collection, focus group discussions and interviews with various stakeholders. Data was mainly collected from ten districts: Tangail, Dinajpur, Sathkira, Kushitia, Natore, Chittagong, Kurigram, Sirajganj, Feni and Pabna, covering primary and secondary milk zones, meat producing zones, urban and peri-urban areas and less developed zones.

Based on the initial findings and secondary data, the international team then conducted the analysis with the support from a few national livestock experts to form a series of business models and core interventions. Therefore, this report is the preliminary result of the 3ADI+ inception work.

3. Analysis

This section presents an overview of the dairy and meat sub-sectors in Bangladesh, starting from an analysis of current and potential markets of dairy and bovine products and deep diagnostics of the core and extended value chain components, as well as the enabling environment to identify the main constraints and root causes of dairy and beef value chains.

3.1 Overview of the value chain

Dairy and beef are major components of livestock sub-sector in Bangladesh. They occupy a crucial place in the national economy because primarily it provides rich nutrition in the form of dairy and bovine products. Apart from these, cattle can serve as raw materials in the form of hides and skins, bones, hoof and horns. The cow dung can be used as organic fertilizer and biogas production.

The demand for milk and meat consumption is increasing because of the rapid increase in population, the spread of education, economic growth and growing nutrition awareness. A decade ago, the availability of milk was only about 50ml/h/d, but significant changes have taken place in milk production during the last decade. As a result, currently the availability has increased to 158 ml/h/d against the recommended consumption of 250m/h/d. Meanwhile, the processing capacity of industrial dairies has been improved a lot as well. Recently, more than half a dozen milk processors are processing about 10 lakh liters of fresh milk daily, which is more than double the amount they could process a decade ago. Regarding beef production, Bangladesh has traditionally been a meat-eating country while until 2018, the government for the first time declared self-sufficiency in meat production (with a production of 72.6 Lakh Metric Ton against 72.14 Lakh Metric Ton of demand[4]).

The milk production in Bangladesh is dynamic and varies from district to district. The primary milk zone is in Pabna-Sirajganj area, characterized by high-yield crossbreed cattle, better access to market and services and deep penetration of industrial dairies. The raw milk produced in this area is collected through different channels and supplied to major urban cities. Since the government emphasizes the necessity of dairy development in its 7th Five-Year Plan, there are more and more milk production zones emerging, even in suburban areas like Gazipur and Tangail. However, cattle farming is still largely dominated by smallholders in rural areas.

The recent trend of the dairy value chain is the quick spread of industrial dairies, including not only the leading firms but also the small and medium-sized entrepreneurs. Consumers in urban cities have better access to a variety of processed dairy products like yoghurt, pasteurized and UHT milk, flavored milk, etc. through retail shops and supermarkets. Compared to expand of industrial dairies, the traditional processors of sweetmeats are mostly family-based businesses and target mainly local consumers. The milk made sweetmeats are so popular and favored that in order to produce hundreds of varieties, the sweetmeat industry as a whole absorbs almost 75% of the total raw milk supply.

The meat consumption is Bangladesh has its deep link with its national cultural and religious background. The beef value chain is much shorter and less complicated than the dairy's. With minimum influence of beef industries, the majority of cattle are still slaughtered and sold in a traditional way. Wet markets are the most welcome place to purchase beef as it is considered to be "fresh". However, because of the traditional way of slaughtering, food safety becomes a major concern for beef sub-sector.

Although the beef value chain is rather straightforward, the by-products are of equal importance to be taken into account. Most of the by-products are generated during the slaughtering and butchering process. By-products like

[4] Livestock Economy at a Glance (2017-18), DLS, http://dls.portal.gov.bd/sites/default/files/files/dls.portal.gov.bd/page/ee5f4621_fa3a_40ac_8bd9_898fb8ee4700/Livestock%20Economy%20at%20a%20glance%20%20%282017-2018%29.pdf

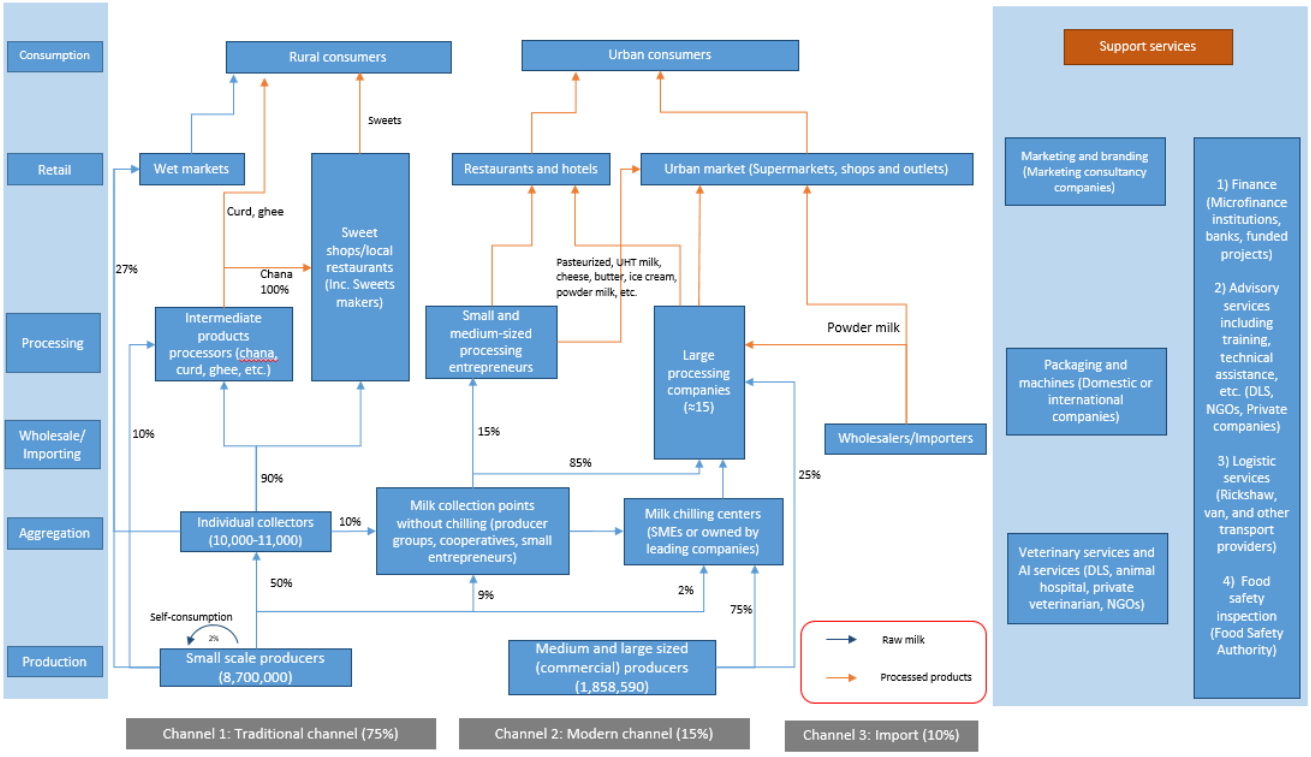
hides, bones and cow dung are gradually being fully collected or used, whereas animal blood is completely neglected and wasted in a considerable amount.

In conclusion, both dairy and beef value chains usually start with small-scale cattle rearing farmers while thereafter demonstrating very distinguished features. More concrete analysis will explain explicitly in the following sub-sections.

3.2 Value chain map

3.2.1 Dairy value chain at national level

Figure 2: Bangladesh dairy value chain map



The dairy value chain is one of the most dynamic sub-sectors in Bangladesh livestock sector and critical to the country's rural development. The above dairy value chain map reflects how the milk flows from farm to end consumers, as well as the key stakeholders within the core and extended value chain. Three main channels can be distinguished from the overall value chain:

1. The traditional channel (75%): The Bangladeshi dairy sub-sector is dominated by the traditional channel. Dairy cows are by far the most important farm animals in this country. The majority of milk producers are small-scale farmers (below 10 cattle), with nearly 8,700,000 in the country, yet their milk production is relatively limited. While the number for medium and large farmers is around 1,858,590[5]. Rural households keep around 0.5-1L per day for household consumption, accounting for less than 2% of the total milk production. A large amount of raw milk is supplied to milk collectors (locally called "goalas") or directly to sweetmeat makers, accounting for 50%

[5] Estimated by authors and experts, using a total cattle population of 24,086,000 while 40% of rural population own cattle.

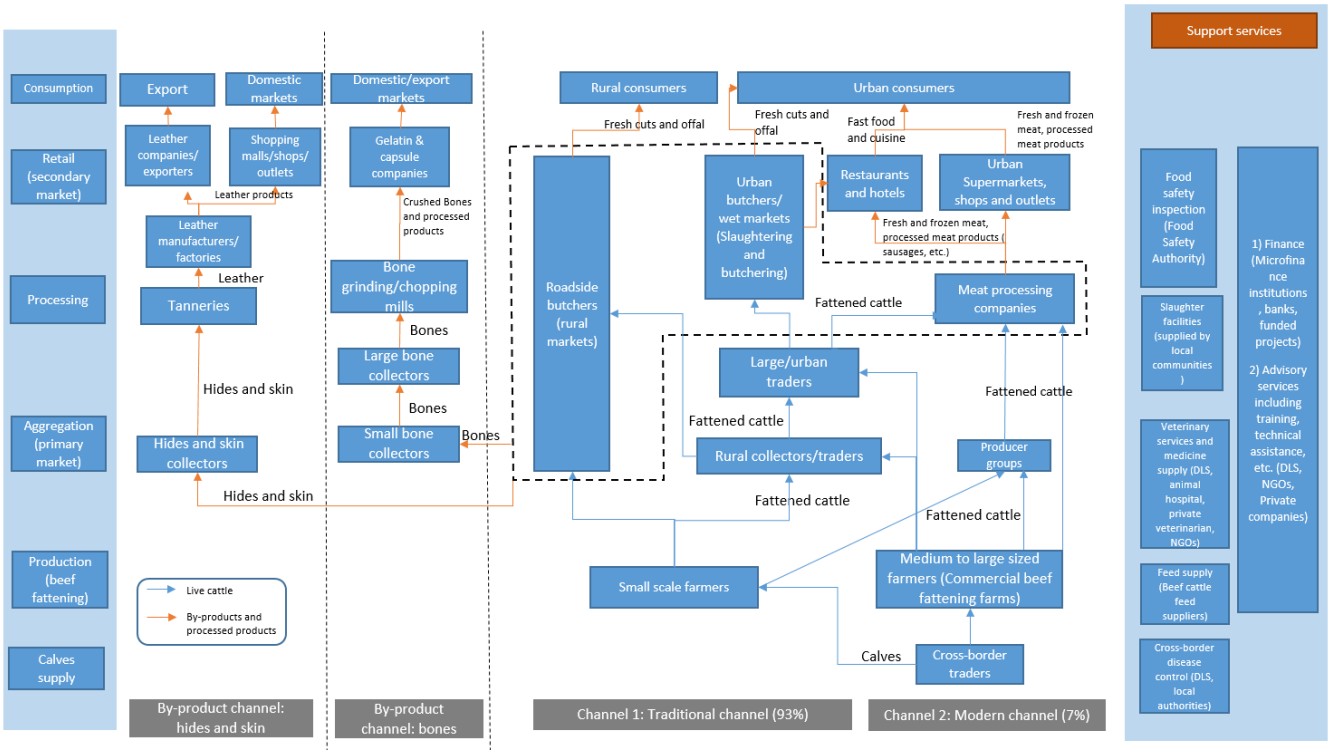
and 10% separately. In average, about 15-25 goalas in each Upazila involved in milk collection, which makes in total around 10,000 to 11,000 at national wide. Almost 90% of the milk collected by goalas flows to intermediate products processors, sweetmeat makers and sweetshops. The rest is sold directly in the local markets or supplied to bakeries and tea shops. In terms of the intermediate processed products, 100% chhana is used to produce sweets, while curd and ghee are sold straight to consumers. Made from chhana, various types of sweets are then marketed through sweetshops and restaurants. There is no exact number for the total number of traditional processors. Based on the surveys and interviews, we estimate that in total there are 109,520 processors involved in chhana and sweetmeat making industry.

2. Modern channel (15%): This is a fast-growing part of the value chain, as more value-added products can be produced through this channel. The modern channel is dominated by industrial dairy actors. As the freshness of milk is highly susceptible to temperature and conserved time and consumers are more aware of the food quality, dairy companies are extending their collection points closer to milk zones. These collection centers often have more advanced refrigeration equipment and milk detection facilities, and dairy farmers can get fair prices based on the fat content and obtain embedded services. For this reason, currently nearly 10% of producers and collectors have shifted to village milk collection centers, run by leading companies and SMEs. All milk sourced from the collection centers is then transported to the processing plants and made into yoghurt, curd, UHT milk, flavored milk, powdered milk and so on. Compared to large industrial dairies, SMEs have relatively limited varieties. Leading firms like Milk Vita, BRAC dairy (Aarong) and Pran dairy have taken 88.56% of the market share for processed dairy products. The key target consumers are mainly urban consumers, who prefer to have diverse choices in terms of brands, quality and varieties. They approach the processed products through retail shops, supermarkets, restaurant and hotels.

3. Import channel (10%): Due to the low milk production in the past decades, it was still challenging to meet the domestic demands of consumers. Thus, a large number of imported milk powder entered the domestic market to fill this gap. Although the government has vigorously supported the development of the domestic dairy industry in recent years, the growing industrial demand and household consumption still make the country dependent on imported milk powder. International branded powdered milk and locally repackaged powdered milk can be both found in the wholesale and retail markets. The wholesale market targets more industrial users for processed dairy products making, while consumers often purchase from retail shops. As the country encourages domestic milk production, the import channel might be gradually substituted by domestic supply, if the price of domestic products is competitive.

3.2.2 Beef value chain at national level

Figure 3: Bangladesh beef value chain map



The map above shows the beef value chain and two associated by-products channels. In Bangladesh, beef is one of the major diets and the demand for beef often increases sharply during the annual religious festival, particularly Eid-ul-Azha. Throughout the overall beef value chain, there are two main channels: traditional channel and modern channel, reflecting how cattle flows from the fattening stage to slaughtering and processing stage (in traditional and modern ways) and ultimately to end consumers. Two by-products channels are shown on this map as well, which reflect how they link to the core beef value chain and how these by-products flow to the corresponding industry chains.

1. Traditional channel: The traditional channel accounts for nearly 93% of the beef supply in Bangladesh, which has remained dominant. Every year beef cattle will experience a surge in demand during important religious festivals, and farmers mainly source their cattle through two ways. On the one hand, the smallholder farmers supply bulls born on their own farms directly to butchers or traders; on the other hand, farms which are close to border areas often obtain cattle from neighboring country through informal cross-border trade, accounting for XX% of total beef cattle supply. Traders sometimes have multiple roles, some of them are not only calves suppliers, but also important middlemen in terms of transporting beef cattle from farms to slaughterhouses, particularly to urban markets. Both in rural or urban areas, consumers prefer to buy freshly slaughtered beef directly from butchers in the wet markets.

2. Modern channel: The modern channel is existing in Bangladesh but it is not the mainstream. There is only one company, Bengal Meat, leading the industrial processing sector. The company generally sources cattle from abroad or from particular producer groups. The fresh and processed products are then sold through retail stores,

supermarkets, restaurants and hotels. Meanwhile, since the price is not competitive internationally, the company also has difficulties in exporting. As a result, this channel is still being marginalized.

3. By-product channel - bones: As one of the main by-products, bovine bone is usually separated from the meat and offal during slaughtering and then collected by bone collectors. The bones from the urban markets (such as Dhaka) are almost 100% collected. After chopping and crushing the bones, all the crushed bones will be supplied to gelatin and capsule companies, and will eventually be sold to domestic and foreign markets.

4. By-product channel – hides and skin: Similar to bones, cowhide is also an important by-product. 100% of the cowhide in the urban and suburban areas is purchased by the hide collectors, and 60% is sourced from rural areas. The hide collectors often maintain a good connection with slaughterhouses and butchers. After collection, all hides are transported and supplied to the tanneries and will be further processed in the leather factories. The final leather products will be sold to national and international markets through global companies or retail stores.

3.3 End-markets

3.3.1 Dairy market

Definition of the market

As the diagnostic examines the value chain for locally produced fresh milk, the end-markets analyzed include those for fresh milk and for dairy products processed from fresh milk. Three distinct dairy end-market segments exist in Bangladesh, each supplied in varying degrees by a combination of local milk and imported powdered milk. These include the market for milk consumed in liquid form, the market for traditional dairy products, and the market for industrial sector dairy products (which also includes packaged pasteurized and UHT milk).

Imported dairy products, including imported powdered milk, and the products made from imported milk powder, are considered substitutes to the products of national origin. Bangladesh imports a significant quantity of milk powder, which is consumed directly as liquid milk after being mixed with water, and is also used by industrial dairy processors. The processors of traditional dairy products use very little powdered milk.

Therefore, segments of the liquid milk market include milk consumed fresh, and milk mixed from powder. Segments of the traditional and industrial dairy product markets include products made entirely of local milk, and products made from a mix of local milk and imported milk powder.

The scope of the analysis is national. With the exception of powdered milk, the quantities of the other imported dairy products are so small as to have an insignificant impact on the national dairy market. Likewise, milk product exports are insignificant.

Milk production in Bangladesh

In order to understand end-market sizes, it is important first to quantify the amount of milk produced locally. The total milk production of Bangladesh reached 9,406,000 MT in 2017-18, as shown in the table below. Just under half of this production was from bovine animals. Goats produce the majority of the fresh milk, at 54.2%, with cows producing 42.4%, buffalos producing 1.8%, and sheep producing 1.5%. Only about 1% of the local grid of milk consumed by humans comes from goats, and only about 4% comes from buffalo. Therefore, almost exclusively, bovine milk is aggregated in the dairy value chain for consumption and processing.

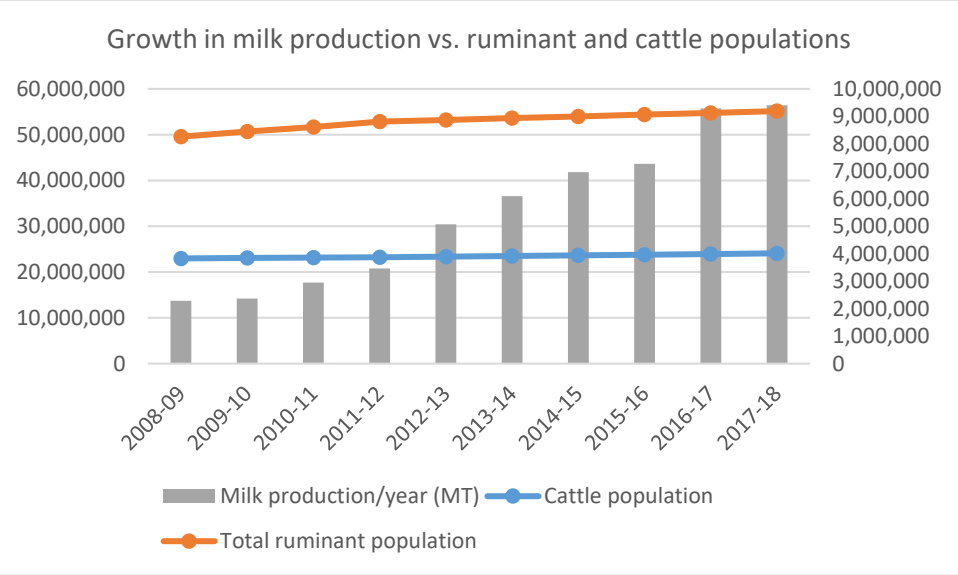
Table 1: Local fresh milk production in 2017-18

	Percentage (%)	Quantity (MT)
Total milk produced in the country	100.0%	9,406,000
Total milk produced by cows	42.4%	3,988,144
Total milk produced by buffalo cows	1.8%	169,308
Total bovine milk production	44.2%	4,157,452

Source: DLS statistics, FAOSTAT, and consultant calculations

While both the cattle population and the total ruminant population have grown at less than 1% for the last ten years, milk production has increased more dramatically – a result of Bangladesh's overall successful breeding policy and artificial insemination delivery mechanisms. As only about 40% of the cattle in the country are cross-breed, a high potential exists for milk production to continue increasing until the national demand for milk is satisfied. The graph below represents the increase in the total ruminant population on the left axis, and the growth in milk production on the right axis.

Figure 4: Increase in ruminant and cattle populations vs. growth in milk production



Source: DLS statistics and consultant calculations

The average annual growth rate in bovine milk production from 2010 to 2018 was 19.5%. Prior to this period, milk production increased at about 3.5%, and was outpaced by the growth in milk consumption.[6]

The per capita availability of local fresh milk (from all ruminants) reached 125.59 ml in 2015-16, 157.97 ml in 2016-17, and 158.19 in 2017-18. This falls short of the World Health Organization's recommended daily intake of milk, of 250 ml per capita. While the total milk production per capita is often referenced in discussions on the topic of national milk self-sufficiency, the comparison is not meaningful as a market measure for multiple reasons: as noted, the milk of small ruminants is almost unconsumed by humans; the national per capita demand for milk in

[6] Uddin, M., Sultana, M. N., Ndamni, O. A., Alqaisi, O., Hemme, T., & Peters, K. J. (2011). Milk production trends and dairy development in Bangladesh. Outlook on Agriculture, 263-267.

Bangladesh is lower than WHO's recommended intake; and, imported powdered milk increases the availability of milk in the country.

Market segment breakdown for locally produced fresh milk

Of bovine milk, 15% is consumed by the producer families, while 80% is traded informally, with only 5% aggregated through the formal sector collection schemes of the industrial processors. Of the milk that is traded informally, 37.5% is purchased for direct consumption by non-livestock owning households in the milk production zones (30% of the total production), and 62.5% is used by traditional processors to make a variety of products (50% of the total production). Thus, in total, 45% of the local milk production is consumed fresh. Of the local milk purchased by processors, 90% goes into the traditional channel, and 10% to the industrial channel.

Table 2: Market segments for local milk, with 2017-2018 quantities

	Percentage (%)	Quantity (MT)
Of bovine milk:		
Consumed by producer families	15.0%	623,618
Traded informally	80.0%	3,325,962
Collected and processed by industrial sector	5.0%	207,873
Of traded informally:		
Consumed fresh (30% of total bovine milk)	37.5%	1,247,236
Processed traditionally (50% of total b. milk)	62.5%	2,078,726

Source: DLS statistics, expert interviews, and consultant calculations

Market of milk consumed in liquid form

The market for plain milk consumed in liquid form is composed of three similar products: (1) locally produced fresh milk; (2) packaged pasteurized and UHT milk, which is an output of the industrial processing segment; and, (3) powdered milk which consumers buy in retail locations and mix with water to make liquid milk. The industrial processors use both liquid milk and recombined powdered milk to make packaged milk. Additionally, the powdered milk sold retail in Bangladesh includes powder made by Bangladeshi processors from locally produced milk, as well as imported powdered milk, although the greater share of the market is imported. Not included in this segment are industrial products such as flavored milk (which has a higher sale price), and other traditional and industrial drinking milk-based products.

As shown in the table, the largest segment by quantity and value is fresh local milk. Even though local milk has the lowest per liter price, its market value, at 84.2 billion BDT, is greater than either of the alternative products. A price of 45 BDT/liter is used in estimating market value, as producers selling milk directly to consumers gain a price which is higher than the national reference price set by the industrial parasternal dairy BMPCUL, of 35 to 40 BDT/liter.[7]

[7] The price discussed is that at which producer or collectors sell milk directly to consumers. Prices paid by industrial and traditional processors function according to slightly different demand and supply dynamics.

Table 3: Retail market sizes for milk consumed in liquid form, in 2017

	Percent of market by quantity (%)	Market size by quantity (MT)	Retail price (BDT/L)	Market size by value (BDT '000)	Market size by value (USD '000)
Of milk consumed as liquid:					
Local milk consumed fresh	62.2%	1,870,853	45.0	84,188,403	1,000,456
Packaged pasteurized and UHT milk	27.6%	831,200	70.3	58,391,800	693,901
Powdered milk consumed as liquid (LME)	10.1%	304,273	62.5	19,017,038	225,990

Source: DLS statistics, market reports, primary market research, expert interviews, consultant calculations

Actually, the producer price of milk varies widely in Bangladesh, from 30 to 70 BDT/liter, due to many factors. In the primary milk zones such as Sirajganj and Pabna, the price paid by the industrial processors, of 35 to 40 BDT/liter establishes the reference price for other buyers. In the northern milk zones such as Rangpur and Dinajpur, milk production is high compared to demand, and for this reason, the milk price is comparatively lower in comparison to areas with lower milk production. In areas with low or medium milk production located near urban centers, the milk price can reach 60 to 70 BDT/liter, due to high demand. In remote areas, the price may fall to 30 to 35 BDT/liter due to the lack of production and limited market access. Prices also fluctuate seasonally. In the primary milk zones, the fluctuation does not exceed 5%, but the variation is greater in zones experiencing more seasonal impacts. Finally, researchers often use a median price of 50 BDT/liter, however the consultants found a lower weighted average price at the national level.

At the typical producer price of 40 to 45 BDT/liter in the production zones, local milk is more affordable than either pasteurized milk or powdered milk. However, urban consumers do not have access to this less expensive and generally safer milk. Urban consumers drink packaged milk or purchase powdered milk to blend with water. While full cream UHT milk has an average price of 90 BDT/liter, and low-fat UHT milk reaches 120 BDT/liter, pasteurized milk retails at an average price of 65 BDT/liter. Thus, a weighted average price of 70.3 BDT/liter is used in the proceeding table. Pasteurized milk is preferred over UHT milk for taste and other characteristics.

Retail packages of milk powder sell for 480 to 520 BDT/Kg. At about eight liters of blended milk per kilogram of powder, one liter of milk made with powder costs 62.5 BTD/liter. Therefore, the price of one liter of pasteurized milk and one liter of powdered milk blended with water is not significantly different. However, powdered milk can be further diluted to reduce cost. Additionally, various incentives beyond price also motivate the purchase of powdered milk, including its easier accessibility at more shops and kiosks, its non-perishability in the face of electricity cuts, and the lack of refrigeration in many homes.

Table 4: The range of packaged drinking milk product prices in Bangladesh

	Aarong (BDT/kg)	PRAN(BDT/kg)	Fresh(BDT/kg)	Milkman(BDT/kg)
Pasteurized liquid milk (FC)	65	65	NA	NA
UHT milk (FC)	90	90	80	90
Flavored milk	125	100	NA	100

Sources: supermarkets, online shops

Additionally, consumer trust has been undermined for packaged milk and powdered milk. When industrial dairies fail food safety tests, which identify e-coli or salmonella in the milk, these failures are widely publicized. As a result, consumers usually boil even packaged milk before consuming it. Likewise, a scare over melamine contamination in milk powder imported from China created reluctance on the part of some consumers to purchase powdered milk. As a result, consumers prefer to buy fresh milk from farmers whom they know and trust, when they have the possibility. Farmers sell milk to regular clients, as well as at local wet markets. While most farmers prefer the convenience of selling to a collector who supplies processors, some farmers choose to sell milk to consumers, in order to gain a slightly higher margin, and for the immediate cash flow. Collectors usually pay every two weeks or less frequently.

Market of traditional dairy products

Traditional processors purchase milk from collectors or directly from larger-scale farmers. They extract low fat or full-fat chhana (consisting of milk protein and varying amounts of fat) from the milk, and use the chhana to produce sweetmeats and other products. Additionally, two sub-sectors are included within the traditional processor segment: traditional processors who source milk to make sweetmeats, and intermediate processors who make only chhana from the milk. The importance of sweetmeats, as a traditional culinary tradition in Bangladesh, has been recognized since Vedic times (five thousand years ago), and the variety of ways in which milk is used for the preparation of indigenous sweetmeats has developed as an art. No ceremony, religious or traditional festival, is recognized without sweetmeats. On occasions such as the Eid festivals, Puja festival, birthdays, marriage ceremonies, funerals, Milad Mahfil, New Year's Day, the celebration of graduations, and for any kind of party or for the entertainment of guests, at the domestic and national level, sweetmeats are inevitable in Bangladesh. Although there are many varieties of sweetmeats (50-100), some of the most popular include rasogolla, rasomalai, cham cham, kalojam, malaikari, peda, danadar, rajvog, kachhagolla, rasakadam, lalmon, and gursandesh. Different sweetmeat making clusters in the country are more famous for different types of sweetmeats.

The traditional processors are also the retailers of their own products, which people purchase to take home for celebrations, or consume directly in small restaurant-like settings often attached to the sweetmeat processing areas. While the many traditional and new sweetmeats varieties make up the majority of their production, traditional processors also make curd, ghee, and other milk derivative products. Sweetmeats and the other traditional products are consumed by all income segments of the population, and across every district of the country. From the 2,078,726 MT of fresh milk used by traditional processors across the country in 2017, they made approximately 1,636,997 MT of sweetmeats (using an average processing ratio of 78.75%), which had a retail market value of 294.7 billion BDT. As shown in the table below, the market for traditional products is the largest dairy market segment by value.

Table 5: Retail market size for traditional dairy products, in 2017

	Percent of market by quantity (%)	Market size by quantity (MT)	Retail price (BDT/Kg)	Market size by value (BDT '000)	Market size by value (USD '000)
Traditional sweetmeats (rasogolla)[8]	100.0%	1,636,997	180.0	294,659,411	3,501,597

[8] While up to 100 different sweetmeat varieties exist, for simplification, the analysis uses rasogolla, one of the most traditional and common sweetmeats as an example. Rasogolla has a processing output of 78.5% (milk to rasogolla), which depends on the output of chhana from the milk as well as the addition of other ingredients to the sweetmeat.

Source: DLS statistics, primary market research, expert interviews, consultant calculations

A conservative price is used in the table, representing the output of the traditional/informal sector sweetmeat makers, who do not use advanced techniques and produce a sweetmeat of average quality. Field surveys conducted by 3ADI+ reveled sweetmeat prices ranging from 120 to 280 BDT/Kg. Several of the traditional sweetmeat makers have grown into national chains, including sweetmeat companies from India which have opened operations in Bangladesh. Regardless of their size, large companies still use artisanal and manual processing methods. Prices of these premium sweetmeats, made by the larger urban sweetmeat chains, can surpass 1,000 BT/Kg.

Table 6: The range of prices for select sweetmeats in Bangladesh

	Traditional processors (BDT/kg)	Premium Sweets (BDT/kg)
Chom Chom	150-200	604-652
Roshogolla	150-200	430
Kolajam	170-200	430
Sada Dsanadar	130-180	NA
Jamrul	180	478
Pyara sondes	200- 220	1561
Sondesh	320-420	865-952
Barfi Sondesh	280-350	NA
Khir Sondesh	350	865
Katarivog	320	NA
Sponse Misti	200	NA
Roshmolai	180-320	691

Source: interviews and online shops

Table 7: The range of prices for Ghee, Curd and Labang in Bangladesh

	Intermediate processors (BDT/kg)	Aarong (BDT/kg)	Pran (BDT/kg)
Ghee	850-1000	1028	1028
Curd	110-220	NA	180
Sour Curd	80-140	NA	150
Labang	250	110	120

Source: interviews and online shops

The traditional sweetmeat makers generally do not use powdered milk on a regular basis. For the rural and peri-urban sweetmeat makers, local fresh milk is usually more affordable than most brands of powdered milk. However, the price at which they purchase local milk varies based on their location (the level of development of the milk zone or sweetmeat cluster) and seasonality. Traditional processors purchase fresh milk at prices ranging from 32 to 60 BDT/liter. Based on field surveys, the lowest prices were found in Dinajpur during the flush season. Dinajpur is in the northern milk zone (called a secondary milk zone in the 3ADI+ report) in which milk production surpasses demand. The highest prices were in Tangail during the lean season (60 BDT/liter), Natore during the lean season (50 BDT/liter), and Chittagong and Feni during any season (50 BDT/liter). Prices in the milk production areas of Sirajganj, in the primary milk zone of the country, ranged from 40-45 BDT/liter – slightly higher than the

industrial dairy reference price. Average prices across all 3ADI+ research districts were 41 BDT/liter in the flush season and 44 BDT/liter in the lean season. These prices represent the cost of milk which traditional processors purchase from collectors, and not producer prices.

While the industrial dairies import most of the full cream milk powder, skim milk powder is imported by other companies and sold in wholesale markets around the country. The liquid milk equivalent (LME) price of the full cream milk powder averages 40 BDT/liter LME, whereas prices for skim milk powder – used most often in manufacturing – ranges from 25 to 45 BDT/liter LME, depending on the country of origin. Therefore, while the majority of milk powders are more expensive or on par with the average prices processors pay for local milk, processors in different regions pay different milk prices, and the lowest quality wholesale skim milk powder is cheaper than local milk – even in rural and peri-urban settings.

However, using this cheap milk powder is a violation of food safety norms, particularly as this milk powder may contain too high of concentrations of toxic substances. Further, as discussed in the core value chain analysis of sweetmeat makers which follows, the generally high profitability of their businesses does not create pressure to reduce input prices by using poor quality milk powder. When traditional processors use powdered milk, it is often on a seasonal basis, as there are some spikes in demand for sweetmeats, due to festivals and celebrations, which fall during the lean season. During these times, processors may be unable to purchase a sufficient quantity of milk; or, their suppliers may add water to the milk to artificially inflate the volumes, which still results in the processors being unable to extract a sufficient quantity of fat and protein. Further, the taste of the sweetmeats differs when made with fresh milk or powdered milk (and with the quality of the milk). Therefore, a variety of factors influence traditional processors to generally, but not always, use more local milk.

On the other hand, the industrial processors that make sweetmeats, and the larger premium sweetmeat chains, use powdered milk on a regular basis as part of the processing formulas for specific sweetmeat varieties. The companies that produce these traditional products include the larger formal sector companies, medium-sized formal sector sweetmeat makers with a few shop outlets, small processors who are still registered and pay taxes and so participate in the formal sector, and other smaller town and village-based processors in the informal sector.

Finally, while the sweetmeat market is the largest dairy market segment in value, and nearly in size, its growth is not unlimited. Already it consumes the largest amount of fresh milk, as compared to any other intermediate milk market (using 50% of local milk produced, as compared to 45% drunk fresh by consumers). However, during 3ADI+ research, most processors described the greatest constraint in their business as being limited market growth. The highly fragmented nature of the processors, who number over 100,000 in the country, in an industry with low barriers to entry, has resulted in a very competitive market for these traditional but undifferentiated products. In the future, the share of milk used by the traditional processing segment cannot be expected to grow as fast as the share consumed fresh by consumers. While the consumption of milk fresh by consumers in Bangladesh still lags behind neighboring countries, such as India, sweetmeat consumption essentially equals demand.

Market of industrial dairy products

Fifteen major companies produce packaged milk and other dairy products in Bangladesh using modern, industrial manufacturing. Several of them produce a wide range of dairy products, while others focus on the more mass market products of pasteurized milk, ghee and curd. The major industrial and integrated dairy companies, which lead the market, include the government-owned Bangladesh Milk Producers Co-Operative Union Ltd. (BMPCUL), selling under the Milk Vita brand (40% market share of milk collected); PRAN Foods Ltd. (24% market share of milk collected); and, the social enterprise the BRAC Dairy and Food Project, selling under the Aarong brand (24% market share of milk collected). They are followed by Akij Food and Beverage Ltd., selling under the Farm Fresh brand (2% market share of milk collected), and several other companies with 1% or less market share of milk collected. PRAN,

which is the fastest growing of the companies, and Akij are parts of major business conglomerates with activities in nearly every sector of the economy. BRAC belongs to the family of social enterprises operated by the NGO of the same name.

Another five companies focus on ice cream production. Companies that focus primarily on the ice cream segment include (listed in order of largest market share) Abdul Monem Ltd., selling under the Igloo brand, Golden Agro Industries Ltd., selling under the Bloop brand; Dhaka Ice Cream Industries Ltd., selling under the Polar brand; and, Kwality Foods. Ice cream making companies collect fresh milk from farmers, although the major ingredient to ice cream is powdered milk, both full cream and skim.

The five or so of the largest companies focusing on sweetmeat production are categorized in the market of traditional dairy products, as they all produce traditional products using manual methods. Some of the larger sweetmeat makers, as well as some of the industrial dairies also have business divisions which produce baked goods such as cakes and cookies, although these are made exclusively with milk powder. Another five or so companies produce sweetened condensed milk, using imported powdered milk.

Plain milk for drinking – pasteurized or UHT – accounts for nearly 90% of the output of the industrial dairy sector. In addition to plain milk, the sector produces flavored milk, butter, ghee, sweet and sour curd, yoghurt, full cream and skim milk powder, mozzarella cheese, Dhaka cheese, labang, lassi, ice cream, sweetmeats, and condensed milk. Certain products come in full cream and low-fat varieties. The primary markets for the industrial dairy sector are in Dhaka and the other major urban areas for the country, including the cities of Chittagong, Comilla, Sylhet and Feni. In urban areas, the top selling products include pasteurized milk, UHT milk and flavored milk, followed by mozzarella cheese (sold primarily to restaurants, including fast food outlets), and yoghurt. In rural areas the top-selling products are ghee and yoghurt, although these areas do not represent viable markets, as the population has access to cheaper local milk, as well as ghee and curd from traditional processors.[9]

The products can be found across the country in supermarkets, shops and kiosks. PRAN, with its huge distribution of many food and beverage products, operates its own retail outlets in addition to selling to distributors. PRAN products are affectionately considered to be sold in every corner and outlet in the country.

As shown in the table below, while packaged plain milk sales account for nearly 90% of the output of the sector by quantity, milk represents less than 60% by value. The other dairy products, which have a higher percentage of fat and require more processing, have more value. Ice cream represents a very small section of the market.

Table 8: Retail market size for industrial dairy products, in 2017

	Percent of market by quantity (%)	Market size by quantity (MT)	Average retail price (BDT/Kg)	Market size by value (BDT '000)	Market size by value (USD '000)
Packaged milk sales (pasteurized and UHT)	88.1%	831,200	70.3	58,391,800	693,901
Non-milk dairy output (less powdered milk)	10.2%	96,200	322.8	31,056,600	369,062
Dairy ice cream (bulk and single portion)	1.7%	16,096	618.2	9,951,000	118,253

Source: Market reports, primary market research, expert interviews, consultant calculations

Of the entire processed dairy market, products made by traditional processors (sweetmeats, curd and ghee) account for 63% of the output by quality and 75% by value. Thus, the traditional processing segment, which is

[9] Source: interviews with industrial dairy processors.

fragmented and operates largely outside of regulatory control, dwarfs the industrial segment both in the usage of local milk and in sales.

In addition, while the traditional segment uses little imported powdered milk, the industrial dairies depend heavily on imported powder. As shown in the table below, nearly 80% of the output of the industrial sector is processed using powdered milk. Powdered milk is used as a regular ingredient in the processing protocols of sweetmeats, curd, lassi, ice cream, and other dairy and bakery products, and also recombined to make up for seasonal shortages in fresh milk supply, to complete the required volumes of pasteurized milk and UHT milk.

Table 9: Local fresh milk and imported powdered milk used in industrial sector processing, in 2017

	Percentage (%)	Quantity (MT)
Local fresh milk used	20.3%	207,873
Imported powdered milk used (LME)	79.7%	815,727

Source: DLS statistics, market reports, primary market research, expert interviews, consultant calculations

The primary reason for the high reliance on powdered milk by the industrial dairy processors is cost. As noted above, currently, imported full cream milk powdered reaches the Dhaka based factories at around 40 BDT/liter LME, compared to 46.5 BDT/liter for the local fresh milk that is collected in the milk zones and transported to the factories by refrigerated tanker truck. Also as mentioned above, the import price of skim milk powder is even cheaper, and ranges from 25 to 45 BDT/liter LME – while the industrial dairies use more full cream milk powder than skim milk powder. Further, the fluctuating global price of milk powder influences the demand of the industrial dairies for local fresh milk. Given the generally lower cost of skim and full cream milk powder compared to local milk, one may expect the industrial dairies to use only powdered milk. However, some products can only be made, or are of a better taste and quality, when made with fresh milk. Additionally, most of the industrial diaries maintain a social mission to help develop the national dairy sector by expanding the collection of local milk. Particularly BMPCUL, as a government-managed union of farmer cooperatives, was developed to provide stable milk markets to farmers.[10]

Growth in milk production and market demand

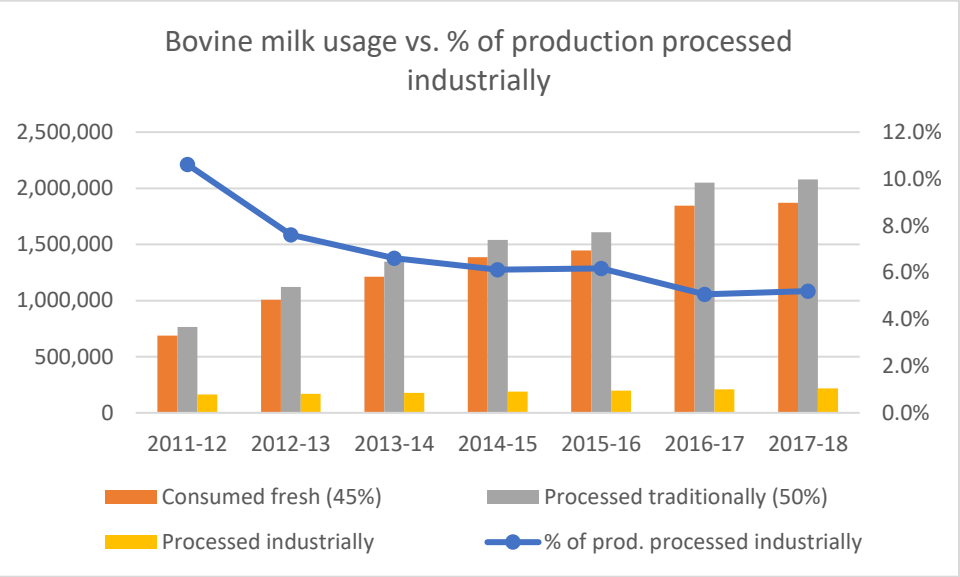
The industrial dairy sector grew at a 3% compound annual growth rate (CAGR) during this period, while most market observers expect the growth rate to increase to 5-7% CAGR in the upcoming years. Since industrial dairy sales depend on urban markets, the current growth rate reflects the country's 1% population growth rate and 3.2% urbanization rate, as well as its rapid economic development. The more optimistic forecasts are based largely on the growth of the urban middle class, resulting largely from the creation of urban jobs, largely in the ready-made garment outsourcing sector.

The graph below compares the quantities of local fresh milk used to manufacture industrial sector products, the local milk consumed fresh, and the local milk used by traditional processors. As no accurate data exists to describe the actual consumption of local milk or its usage by traditional processors, the graph is estimative. However, the trends illustrated are reliable. As bovine milk production has increased in the last decade, the percentage of the milk which is consumed fresh, and which is used in traditional processing, has also increased; however, the

[10] BMPCUL does not import powdered milk, but uses its powder produced from local production in its products. However, BMPCUL operates with indirect government subsidies (such as for the construction of new factories), and so the other industrial sector companies have difficulty competing with it. As a result, the other companies are forced to meet BMPCUL's relatively lower producer prices and to import milk powder to maintain competitiveness in packaged product markets.

proportion of the total local milk supply which is used in industrial processing has decreased – from over 10% in 2011 to around 5% in 2018.

Figure 5: Growth in usage of milk compared to the percent of production processed industrially



Source: DLS statistics, market reports, primary market research, expert interviews, consultant calculations

The increase in milk production was fueled by the countries breeding policies and its work in artificial insemination, as well as some reduction in the cattle disease burden. These policies were supported in the market by an unsatisfied demand for milk by household consumers and by traditional processors. Many new traditional processing businesses continue to be launched in the primary and emerging milk zones – reflecting the growing availability of milk supply and the attractiveness of the industry to small processors. While a few SME industrial processors have also recently started, these represent a new movement within the industrial sector, which is largely dominated by the lead companies.

Projecting a 7% annual market growth in the output of the industrial sector, the companies would require the collection of an additional 40 to 50 MT of milk/day each year. The industrial processor PRAN, which is growing the most aggressively, reportedly plans to launch one new milk collection hub per year for the next five years. As PRAN's milk collection centers have a maximum capacity of 50 MT/day, and the centers reach capacity only after several years of operation, the company seems to be targeting growth at the forecasted rate of 7% expansion annually.

Currently, the primary factor limiting sales of both the traditionally and industrially processed dairy products is the slow growth in demand. In the industrial sector, the few major brands compete for market share using strategies based on distribution and brand strength, rather than on closing existing market gaps. Likewise, in the traditional sector, the many fragmented producers compete with an undifferentiated product in their own localities. The chain sweetmeat makers targeting the more affluent urban consumers also face saturated markets, and have expanded into related products. Processors in both segments have significant unused capacity in their processing locations/factories, but do not increase production due to high competition and slow growth in markets. While the availability of local milk can be an issue in the lean season, overall, a lack of available milk production, is not a constraint to either sector's growth.

Impact of regional production differences on milk supply markets

While fresh milk collected by traditional and industrial processors is in equilibrium with their needs on an annual basis, the fresh milk market is sometimes in deficit on a seasonal basis. The deficits occur during the lean season in certain regions of the country.

Due to the historical development of milk production in some regions, as well as the impact of climate, the proximity to urban demand centers, and the influence of other economic activities, certain geographical areas have become major milk producing zones, while in other areas of the country, livestock rearing remains an undeveloped subsistence activity. As noted above, the producer price for milk ranges from 30 to 70 BDT/liter in the different zones, due to these factors. In some areas in the country, especially during the lean season, milk is unavailable except on a subsistence level. In these areas, during the lean season, fresh milk is in deficit. Processed milk and powdered milk is still available, however at higher prices.

The milk aggregation markets and markets for intermediary processed products are also impacted by regional milk deficiencies. With the exception of the government processor, BMPCUL, which collects milk from nearly every district of the country, the industrial processors focus collection in areas of already established high milk supply. The industrial processors pay the same prices across the country, regardless of the collection zone.

Some intermediate processors, who extract only chhana from milk, operate in areas with high milk supply, and sell the chhana to sweetmeat makers in areas where the milk production is insufficient to satisfy their supply needs. Additionally, collectors often purchase milk in the remote areas at lower prices to re-sell in the more developed milk production areas, where prices are higher. Therefore, myriad small collectors and processors practice some arbitrage to benefit from the differences in milk supply and price in the different production zones, and in the process resolve some of the regional supply gaps to a limited extent.

Impact of seasonality on products and markets

The seasonality of milk production also impacts end-markets, and the types of products which are available. As discussed in more detail in the core value chain report section on production, the period of highest milk production tends to be in the cool winter months from November/December to April/May, with medium production in the hot summer months from May/June to July/August, and lowest production during the monsoon in August/September to October/November. Some variations in seasonality exist by region (the reason for the "/" in the preceding sentence). The difference between the flush and lean season supply is not more than 10% to 20% in the milk-producing regions. This is not a drastic fluctuation, and so supply to the processing segments is relatively constant. Still, in the non-milk producing regions, where most livestock keepers operate as "kitchen farmers" who keep a single local cow, milk supply may dry up in the lean months

Still, industrial processors use different strategies to cope with the seasonality in milk production. They place quotas on the collection of milk during the flush seasons. The quotas are set based on the companies expected sales, so that they do not collect more milk than can be processed and sold. The industrial processors also adjust prices to create incentives for farmers to supply more milk, or to discourage the supply of milk. Prices are also adjusted on a year-to-year basis. The quotas and price adjustments have resulted in livestock farmers in the secondary milk zones (primarily in the far north of the country) transitioning out of milk production to focus on bull fattening.

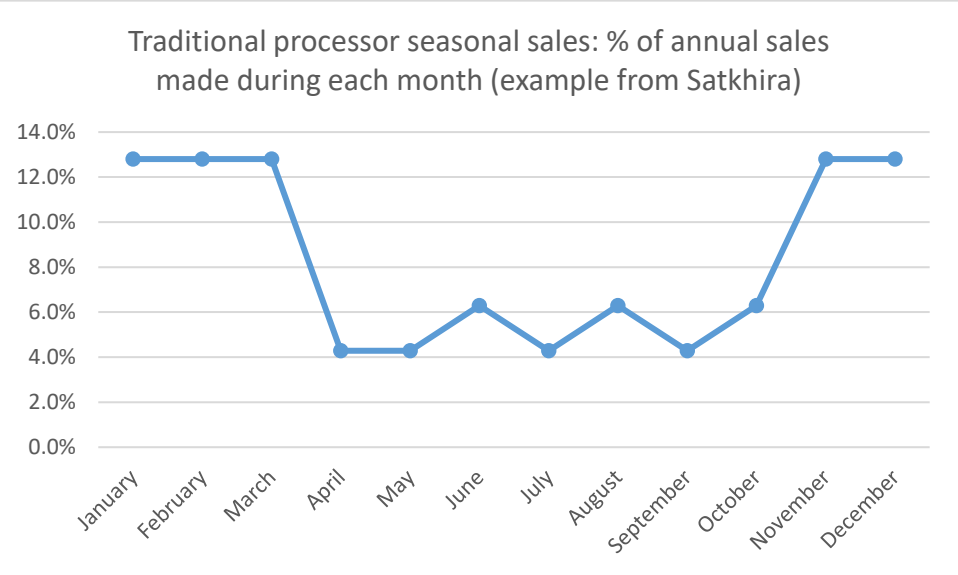
These mechanisms, used to influence the supply of milk, also show that the annual quantities collected by the industrial processors are essentially in equilibrium with their sales. For example, if processors only needed to use incentives to receive more milk, but did not need to institute quotas, such a situation would indicate a supply gap. The present equilibrium – with insufficient milk available in the lean season, and over-supply in the flush season

– indicates that overall, the companies are collecting the optimum amount of milk that is possible within the seasonal variations.

The industrial processors also use powdered milk to adjust to the seasonal variations in fresh milk supply. Powdered milk has a longer conservation life than any other milk product. The largest part of the powdered milk that the processors make themselves, from local milk, is used in their own products. Some of the powdered milk that they produce, as well as some of the imported powdered milk, is used to compensate for the seasonal deficits of fresh milk availability.

Traditional processors operate in local markets and are less effective at dealing with seasonal fluctuations. As shown in the graph below, the seasonality of traditional processor sales varies widely by month. Winter is the high season for the consumption of sweetmeats, as well as during festivals and graduation ceremonies. Luckily for the traditional processors, the main high season for the consumption of sweetmeats coincides with the flush milk production season. However, during the sales peaks which occur during the other periods of the year, collecting a sufficient supply of milk can pose challenges. As noted above, collectors often dilute milk to create the impression of a larger quantity, although the amount of chhana that the processors are able to extract from the diluted milk is not greater. Often during the periods of high demand, sweetmeat makers in the zones with lower milk production are forced to use powdered milk, or to purchase chhana from intermediate processors in zones with higher production. This practice of purchasing chhana that has been transported on buses or trains, often reduces the quality of the sweets.

Figure 6: Seasonal sales of traditional processor

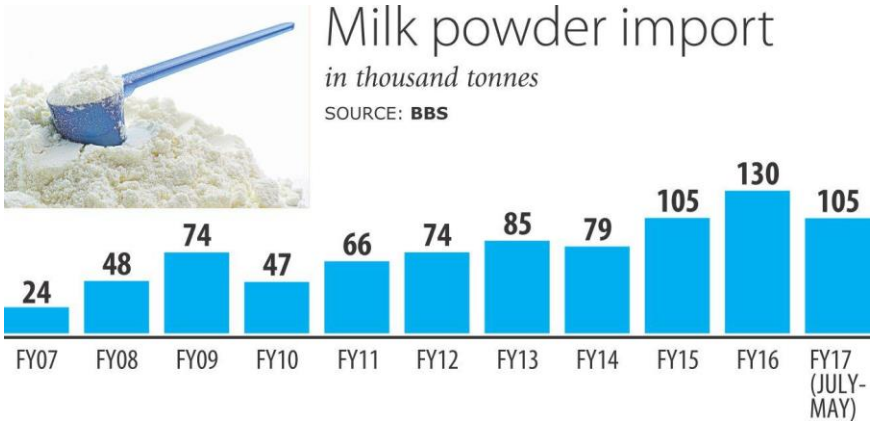


Source: field research with traditional producers, consultant calculations

Dynamics of the powdered milk market

While exports of dairy products are negligible, and imports of most dairy products are also of insignificant amounts, the nation's powdered milk imports provide the exception. Imports of powdered milk have been growing, as illustrated in the graph below. Powdered milk is used both as an input to the industrial processing sector (of dairy, bakery and others) and mixed with water to be consumed as liquid milk.

Figure 7: Powdered milk imports to Bangladesh



Source: https://www.thedailystar.net/business/import-powdered-milk-almost-doubles-1444687

Powdered milk imports have grown at a faster rate than local fresh milk production, over the same period. In 2018, the estimated powdered milk import of 140,000 MT is over 11% of that year's production of fresh milk from all animal types.

The table below breaks down the import of powdered milk according to HTS customs codes. The data includes powdered milk imported through the Chittagong port, which is the largest ocean port in the country, where the bulk of powdered milk is imported. In addition to the Chittagong port, imports enter through land border points from India, as well as through illegal smuggling. Industry participants estimated smuggling to represent only a small proportion of the powdered milk in the country. As the table below presents the majority of powdered milk import, it provides an informative breakdown of product variations, packaging and quantities. The categories include skim milk powder and full cream milk powder, in packages greater than, and less than, 2.5 kg. According to the graph, the largest category is full cream milk powder in packages of less than 2.5 kg.

Table 10: Import of powdered milk through the Chittagong port

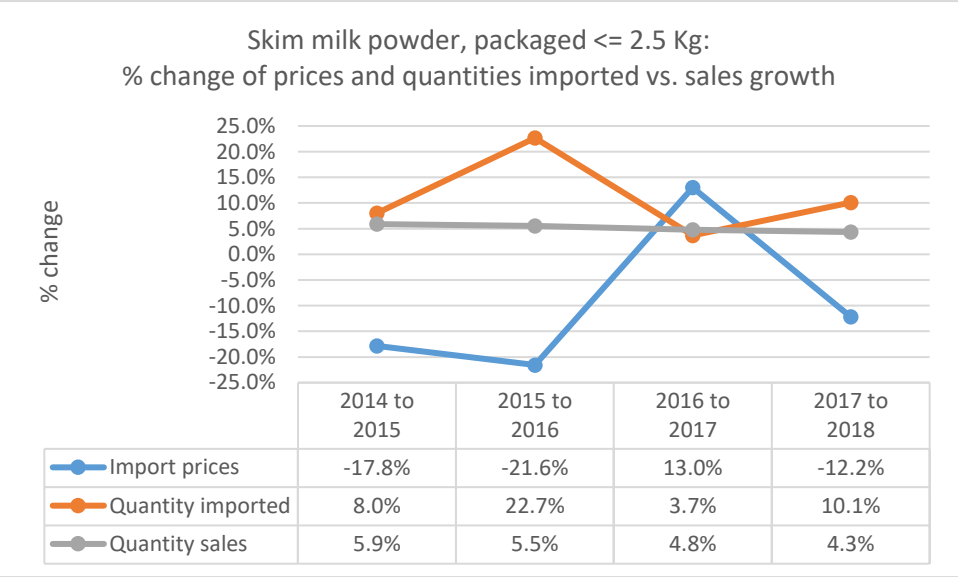
Code	Milk and cream in solid forms:	2014	2015	2016	2017	2018*
04021091	Of a fat content by weight of <= 1,5%, sweetened, in immediate packings of <= 2,5 kg	24,813,375	26,798,425	32,871,475	34,086,850	37,531,316
04021099	Of a fat content by weight of <= 1,5%, sweetened, in immediate packings of > 2,5 kg	4,965,283	5,150,957	4,638,625	2,907,725	4,326,482
04022191	Of a fat content by weight of > 27%, unsweetened, in immediate packings of <= 2,5 kg	36,621,421	47,750,850	48,335,980	52,766,498	53,927,875
04022199	Of a fat content by weight of > 27%, unsweetened, in immediate packings of > 2,5 kg	50,000	0	107,792	136,425	33,975
	Total import volumes	**66,452,093**	**79,702,247**	**85,955,888**	**89,899,515**	**95,819,648**

* Data for 2018 is for January-October only.

Source: Chittagong Custom House, and consultant calculations

The graph below shows the relation between the import prices of skim milk powder in 2.5 Kg packages, through the Chittagong port, and the quantities imported (from the table above). They move inversely, so that when global powdered milk prices decline, more skim milk powder is imported into Bangladesh, and vice versa. Simultaneously, sales growth in the packaged dairy product market (the total sales of all industrial dairy sector products) has been declining slightly. Therefore, the changing quantities of imported milk powder can only displace the collection of local milk by processors.

Figure 8: % Change of prices and quantities of imported skim milk powder compared to the sales growth of the industrial diary sector overall



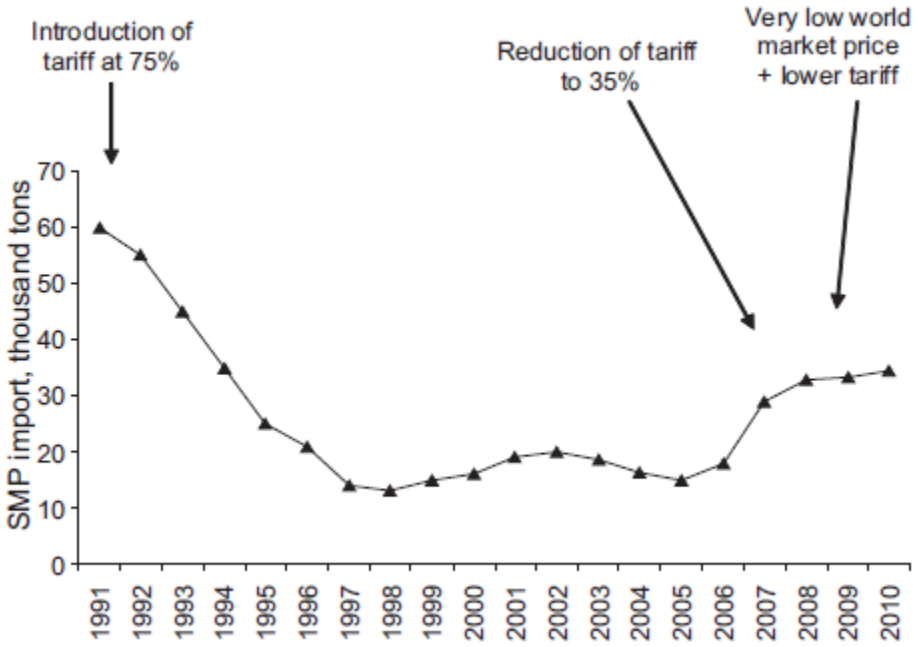
	2014 to 2015	2015 to 2016	2016 to 2017	2017 to 2018
Import prices	-17.8%	-21.6%	13.0%	-12.2%
Quantity imported	8.0%	22.7%	3.7%	10.1%
Quantity sales	5.9%	5.5%	4.8%	4.3%

Source: Chittagong Custom House, and consultant calculations

The imports of full cream milk powder did not show the same tendencies during the years represented. Over the last decades, while imports of skim milk powder fluctuated widely based on the global price, imports of full cream milk powder increased relatively steadily. Import quantities of full cream milk powder are less influenced by global prices.

The relationship between global prices and skim milk powder indicate that global prices influence both local prices and demand for local milk. The graph below further illustrates the impact of the global milk price on imports of skim milk powder, while also introducing the influence of national tariff policy. A tariff increase in 1991 led to a reduction in skim milk powder imports. However, in 2007, import tariffs were reduced from 75% to 35%. The reduction helped the nation cope with the global market price for milk, which reached historic highs in that year, by providing price stability to Bangladeshi consumers. Before 2007, even in the primary production zones, the Bangladeshi price for powdered milk was insulated from, and higher than, the global market price for milk. After 2007, the producer price for milk showed more influence from the global milk price, while generally remaining lower. Currently, although the global milk price has decreased from its 2007 heights, the 35% tariff has not been increased.

Figure 9: Impact of tariffs and global milk price on skim milk powder import



Source: Uddin, M., Sultana, M. N., Ndamni, O. A., Alqaisi, O., Hemme, T., & Peters, K. J. (2011). Milk production trends and dairy development in Bangladesh. Outlook on Agriculture, 263-267.

The high quantities of skim milk powder used in manufacturing exert downward pressure on the producer price of milk in Bangladesh. When the global price for skim milk powder decreases, companies use more milk powder in manufacturing, reducing their demand for local milk. As a result, following the tariff hike, the companies set lower prices for milk in their collection zones. The impact of global prices on local producer prices has the most effect in the primary and secondary collection zones, where the major industrial dairies collect milk. Although BMPCUL collects from nearly every district in the country, many of its collection centers, which are located outside of the primary zones, function at extremely low volumes, or collect primarily from one framer association or even one individual. The trade association of industrial dairies has repeatedly requested the government to increase the tariff on skim milk powder, to no avail.

Imports and exports of other dairy products

Apart from powdered milk, Bangladesh also imports other dairy products but in small quantities and values. The processed products like ice cream (95,000$), cheese and curd (216,000$) and whey and other milk products (4,721,000$) account for only 0.02% of the total import value. These imported products are mainly consumed by a limited amount of elite consumers in the capital and can be only found in a few supermarkets. As regards export dairy products, only a few products were exported which are so minimal that contributed zero of the export share.

Table 11: Dairy products imported by Bangladesh (2018)

Product	Total Value (Thousand USD)	Share (%)	Growth (% 5yr)
Whey & milk product	4,721	0.02	156.09
Chesse & curd	216	0.00	8.31
Ice Cream	95	0.00	76.07
Milk	83	0.00	112.58

Source: Bridgat, https://countries.bridgat.com/Top_Products_Imported_by_Bangladesh.html

Table 12: Dairy product exported by Bangladesh (2018)

Product	Total Value (Thousand USD)	Share (%)	Growth (% 5yr)
Concentrated milk & Cream	13	0.00	275.71
Butter	6	0.00	94.33
Ice Cream	5	0.00	274.22

Source: Bridgat, https://countries.bridgat.com/Top_Products_Exported_by_Bangladesh.html

Comparison of milk consumption among Indian sub-continent countries

Bangladesh consumes less milk than its neighbors. As noted above, the per capita availability of milk (from all ruminants) in Bangladesh reached 158.19 ml/day/capita in 2017-18, compared to the WHO recommended intake of 250 ml/day/capita. By comparison, India's milk availability was 245 ml/day/capita in 2008 and Pakistan's 630 ml/day/capita in 2003.[11] While availability in those countries would have evolved since those years, the higher availability of milk in these culturally similar countries is undisputed.

As these countries share cultural and dietary tendencies, they demonstrate the potential milk consumption levels in Bangladesh. Although traditional and industrial processors face slow growth in markets, local consumers of fresh milk will continue to increase consumption with greater milk availability. In the medium to long term, as economic development continues and purchasing power increases, consumption levels of processed products may also increase.

Milk consumption patterns and characteristics

Urban households spend more than 30% of their food expenses on milk and other dairy products and 30% on bovine-origin products (meat, offal). They mostly purchase dairy products from nearby retail shops or supermarkets. Currently, consumers are more and more aware of the food quality and nutrition, however, they are gradually losing confidence in some branded dairy products because some companies were closed for internal rectification due to quality problems. Therefore, there is a new trend emerging in urban cities. From the interviews we find out that some urban consumers start to choose trustful farms (usually in peri-urban) by themselves and book fresh milk directly from those dairy farms. They believe that the quality from the farms is much better than the packaged milk in the markets. Urban consumers value the importance of taking a balanced diet and define food that is not adulterated and causes no harm to the human body as "safe food".

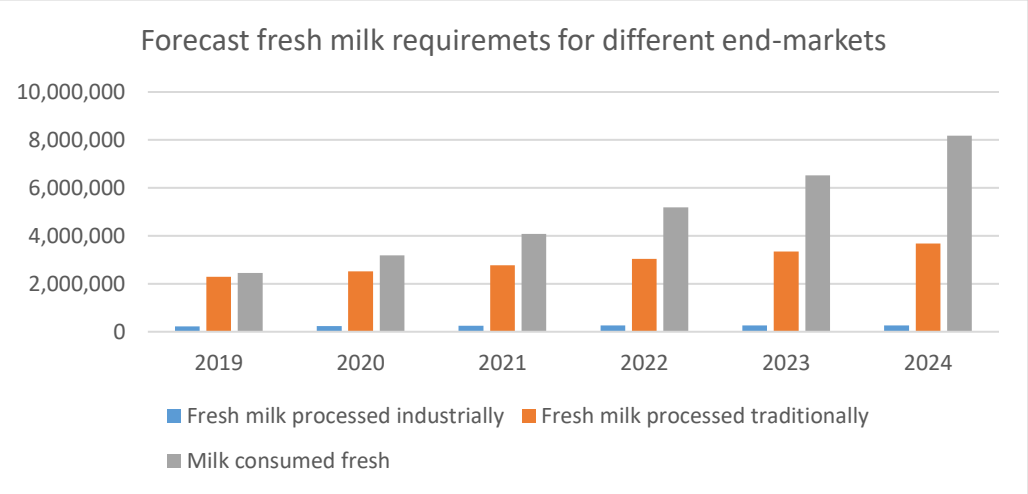
Rural households spend much less, and also consume less compared to urban households. They either take milk directly from own farm or purchase from local producers. They consume more in liquid form by simply boiling the raw milk. Less varieties of processed products can be accessed in rural areas, because most of them are marketed to urban consumers. For rural consumers, price is always a key concern when purchasing milk. They cannot really define what "safe" food is and are not aware of any human diseases caused by animal disease or poor food safety.

[11] Uddin, M., Sultana, M. N., Ndamni, O. A., Alqaisi, O., Hemme, T., & Peters, K. J. (2011). Milk production trends and dairy development in Bangladesh. Outlook on Agriculture, 263-267.

Expected future market growth and fresh milk requirements

The expected future national requirements of fresh milk are forecasted based on current consumption and assumptions of growth. Milk production is forecast to continue growing at the CAGR achieved during the last decade, of 19.5%. The quantity of local milk procured by the industrial processing segment is forecast to grow at 5% annually – an average forecast, between the 3% growth of the last decade, and the 7% future growth expected by some industry observers. The consumption of milk by traditional processors is forecast to grow at 10% annually; at less than the 19.5% growth of milk production overall, consumption share of the traditional processors will gradually decrease as a proportion of the whole. The remaining milk will be consumed as fresh. The graph below shows the end-market breakdown, based on these assumptions, for 2019 and the next five years. The gap between the amount of milk used by processors (traditional and industrial), and that consumed fresh, widens over this time span.

Figure 10: Forecast fresh milk requirements for different end-markets: industrial processing, traditional processing, and fresh consumption



Source: DLS statistics, primary market research, expert interviews, consultant calculations

If milk production continues to expand at the expected rates, the per capita availability of bovine milk will reach 188.57 ml/day/capita by 2024, with the availability of all ruminant milk surpassing the WHO recommended intake by 2022. The forecast assumes that 50% of the milk supply is from bovine animals, which is slightly higher than the current proportions, as cows' milk yield provide increase more rapidly than that of small ruminants.

Table 13: Per capita milk consumption according to forecast (ml/day)

	2019	2020	2021	2022	2023	2024
Per capita milk consumption (bovine)	81.26	96.16	113.79	134.66	159.35	188.57
Per capita milk consumption (all ruminants)	162.52	192.32	227.59	269.32	318.71	377.15

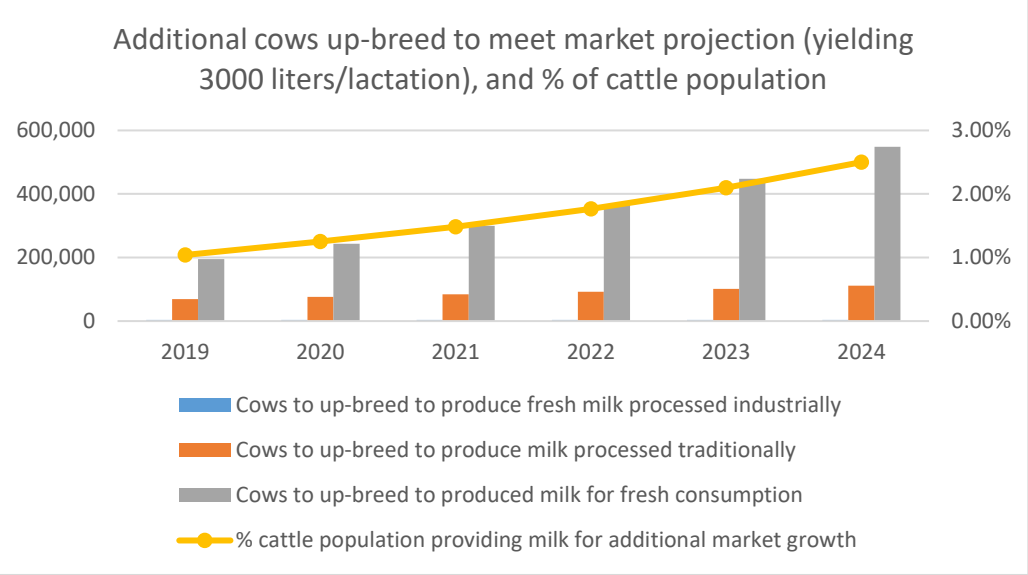
Source: consultant calculations

The forecast of milk production growth equal to that of the last decade, assumes that the Department of Livestock Services (DLS) and its private sector partners, will continue to provide artificial insemination and animal health services to farmers. It also assumes that milk markets and collection systems will expand in parallel with the growth in production. As the access to artificial insemination increases, more cross-breed cows will be born, as compared to the low yielding local variety.

The graph below shows the number of additional cows which, in theory, would need to be up-bred to support the milk production forecast, and the percentage of the total cattle population represented by this number. The graph uses a Holstein-Friesian x local cow cross-breed (with 50-62.5% exotic blood), producing 3000 liters per lactation. Calculating using cross-breeds with less exotic blood, or improved sub-continental breeds, such as Sahiwal, would increase the number of cows required as well as the percentage of the total herd, as the milk per lactation would decrease.

The estimation gives only a frame of reference for the number of up-bred cows which correspond to the expected milk demand of each productive sector (industrial processors, traditional processors, or consumers). In reality, the upgrade would occur gradually across a broader spectrum of the cattle population, rather than to a specific number of cows.

Figure 11: Additional cows to up-breed to provide for market growth forecasts, compared to the corresponding % of the cattle population



Source: DLS statistics, primary market research, expert interviews, consultant calculations

By 2024, the expected market growth would impact a very small percentage of the cows in Bangladesh. Only an additional 1.5% of cows would need to have 50% exotic blood, to meet the projections. The small percentage of additional cows to support reflects the huge cattle population in Bangladesh, as compared to milk market demand. However, the cattle farmers include vast numbers of subsistence "kitchen farmers," and not only the more commercially oriented farmers in the milk production zones. In reality, the supporting services provided by the government, and market creation and other value chain interventions to be provided by international partners such as the UN, will focus on the smaller percentage of farmers in the emerging and present milk production zones. In these areas, proportionally fewer cattle produce the majority of milk required by the national grid.

Conclusions and implications of the milk and dairy product market analysis

Industrial processing market segment: The industrial dairy market endures constrained growth currently, and limited future growth potential. The share milk used by industrial processors will shrink as a share of national milk production.

Additionally, although the industrial processors offer many benefits to farmers, including the provision of embedded services and training, it will become increasingly less advantageous for farmers to supply these larger

companies. Imports of powdered milk continue to increase, limiting the producer price that industrial dairies pay for milk, and making livestock rearing increasingly unsustainable for small-scale farmers. While medium- to large-scale farmers do supply milk profitably at the prices paid by the companies, the majority of farmers are small-scale, and struggle with the prices set by the industrial processors.

Traditional processing market segment: Traditional processors represent the largest intermediary market for fresh milk produced in the country. As the traditional processing segment consumes far more milk than the industrial segment, any upgrading strategy would need to engage them.

Fresh and pasteurized milk consumption: The consumption of local milk by the population is currently the second largest market for fresh milk, and it will become the largest in the future – with the vast majority of milk consumed fresh in the rural and peri-urban areas, and a lesser amount consumed as pasteurized and UHT milk in the cities. The amount of liquid milk mixed from imported powder is also increasing, although the market segment is far smaller than that of fresh milk. The consumption of fresh milk does not add value as it is minimally, or not processed, and all of this milk will remain in the informal sector, traded at local markets and between neighbors. Interventions at the core value chain level can have little direct impact on this purely informal market, so system interventions will be necessary.

Milk production in Bangladesh: The vast majority of fresh milk production also occurs in the informal sector, primarily by small and medium-sized farms. Production is expected to continue increasing, supported by DLS and other service providers, within the limits of national markets. The expected market growth will support the further up-breeding of 1.5% more Holstein-Frisian (HF) x local cows (or more with a lower percentage of exotic blood). (The resulting bull calves born from the artificial insemination activities also provide income to farmers, and increase the market for meat in the country, discussed in the next section.)

Market opportunities: The major market opportunity involves balancing milk supply and demand, between those regions of the country, and based on seasonal surpluses or deficits. Such balancing could be achieved through intra-national trade activities, and particularly by creating linkages between suppliers/collectors and processors in the traditional and industrial sectors, as well as supporting farmers in deficit zones with the potential to emerge as milk zones, to produce more milk.

Another market opportunity would involve increasing the quality and safety of dairy products. Regaining the trust of consumers, that dairy products are safe for consumption, would increase market demand and market size, both in the traditional and industrial market segments. As traditional processors also are retailers, they would also have sufficient control over the downstream supply chain to ensure higher quality to end-consumers.

Additionally, future growth will occur within the markets of the existing products, and within the traditional tastes and local preferences – in both the traditional and industrial processing sectors. Due to the highly traditional nature of Bangladeshi tastes (such as for sweetmeats), product diversification through research and new product development does not offer a significant opportunity to create new markets or generate increasing demand for local milk. Innovations in packaging or convenience may increase the value captured by processors. However, such innovations should not drastically increase the price of products, due to the limited purchasing power of the population.

3.3.2 Beef market

Definition of the market and introduction

As with the dairy sector, the analysis focuses on the markets for beef and cattle by-products from animals of Bangladeshi origin. The beef value chain in Bangladesh depends on the dairy value chain, as essentially all of the beef in the country comes from local animals which have been culled from the national dairy herds. Very few feed

lots, focusing on rearing bulls for consumption purposes only, exist in the country; and, the few that do exist are usually located in dairy areas. Additionally, just under half of the animals slaughtered for beef are old cows, which are no longer productive in milk production. Bulls are mostly slaughtered for the Muslim holiday Eid al-Adha, when about half of the cattle consumed are slaughtered on one day, when religious rites require families to sacrifice a bull.

Those farmers who do focus on bull fattening are generally either medium- to large-scale farmers, or subsistence "kitchen farmers" who raise the bulls by feeding them crop residues and table scraps, with essentially no production costs. Bull fattening poses financial challenges for small-scale farmers who approach livestock rearing as a business, as feeding bulls for fattening requires a daily expenditure, while the cash inflow occurs only when the bull is sold. Additionally, as most small-scale milk farmers are women, they have difficulty manipulating the larger bulls. Small-scale farmers sometimes use the revenues from milk sales to finance feed for their bulls and cows, however with the high cost of feed, the number of animals which farmers can keep using this method is limited.

Therefore, with the high integration between the beef and dairy value chains at the primary production segment, a majority of the animals slaughtered for beef could be considered by-products/waste of the dairy industry. On the other hand, the Bangladeshi market offers a relatively high return for culled animals, as compared to returns in other countries of the sub-continent[12]. As the revenues earned from the sale of milk are often equal to the production costs of cattle rearing, farmers depend on the sale of culled animals to secure a profit from their cattle rearing activities.

The quantity of beef products which are imported or exported is insignificant. Bengal Meat, the only company operating a modern slaughterhouse in the country, was launched with the intention to export beef. However, only small quantities have been exported to markets in the Middle East, largely due to the inability of the company (working in partnership with the government) to guarantee that the meat confirms with international food safety standards, given the uncontrolled situation of cattle disease in Bangladesh.

The usage of cattle by-products is high. A value chain exists for the collection, transport, and processing of bones into gelatin and medicine capsules. Additionally, under normal conditions, the tannery sector purchases all of the raw hides resulting from slaughter. Currently, the relocation of the main Dhaka tannery estate, with the goal of establishing effluent processing to reduce negative environmental impacts, has disrupted the sector, and reduced the purchasing of hides. Hide prices have fallen and some hides are being smuggled out of the country illegally. Tanned hides are exported, with the leather goods and footwear industries importing hides for processing. Other by-products, such as blood, are not collected or processed.

Market size and characteristics of the market for beef

The total supply of meat to Bangladeshi consumers is 2.2 million tons, including all types of commonly consumed animals: cattle, buffalo, sheep, goats, and poultry. Horse and pig are also consumed, but in very small quantities. As the table below shows, about 60-65% of the meat supply is beef, with about 40% of the national cattle herd slaughtered annually. Poultry makes up the largest number of animals slaughtered, although due to their smaller size, chickens and ducks represent the second largest category of meat supply to the nation.

[12] Hemme, T., Uddin, M.M., & Ndambi (2014). Benchmarking Cost of Milk Production in 46 Countries. Journal of Reviews on Global Economics, 3, 254-270.

Table 14: Breakdown of meat supply to the consumer market in Bangladesh

Livestock	National livestock population (2017-18)	% slaughtered annually	Number slaughtered	Smuggled into the country	Total number slaughtered	Carcass weight (Kg)	Meat supply (MT)	% of meat supply
Cattle	24,086,000	40.00%	9,634,400	300,000	9,934,400	146.25	1,452,906	65.45%
Buffalo	1,485,000	40.00%	594,000	0	594,000	211.25	125,483	5.65%
Sheep	3,468,000	35.00%	1,213,800	0	1,213,800	19.50	23,669	1.07%
Goats	26,100,000	55.00%	14,355,000	0	14,355,000	19.50	279,923	12.61%
Poultry	337,998,000	100.00%	337,998,000	0	337,998,000	1.00	337,998	15.23%
Total			**363,795,200**		**364,095,200**		**2,219,978**	

Source: DLS statistics, market reports, primary market research, expert interviews, consultant calculations

The weight of the animals used to estimate meat supply leaves a margin for estimation. The population prefers the meat of the local cattle, which make up the majority of the cattle being slaughtered. The following table provides assumptions for animal weights, using a 225 Kg for the typical cow or bull slaughtered, as the local breed cattle range from 200 to 250 Kg live weight. Full grown male Pabna cattle, in comparison, weigh 350 to 400 Kg each, with females weighing less. Holstein-Frisian crossbreed cattle with 50% exotic blood weigh around a half ton, and a 100% Holstein-Frisian pure-breed weighs over one ton.

Table 15: Body weight of animals slaughtered and of total herd

Livestock	Livestock population (2017-18)	Approx. body weight per animal (Kg)	Body weight of animals slaughtered (MT)	Weight of total herds (MT)
Cattle	24,086,000	225	2,235,240	5,419,350
Buffalo	1,485,000	325	193,050	482,625
Sheep	3,468,000	30	36,414	104,040
Goats	26,100,000	30	430,650	783,000
Poultry	337,998,000	1.5	506,997	506,997
Total			**3,402,351**	**7,296,012**

Source: DLS statistics, market reports, primary market research, expert interviews, consultant calculations

Government (DLS) statistics report a national meat supply of 7,260,000 MT in the same year, which equates to a per capita consumption of 122.10 gm/day. This per capita consumption would indicate that the country is self-sufficient in meat production on a theoretical level, as the WHO's recommended intake is 120 gm/day per capita. The government figures overstate the national meat supply, and seem to be calculated based on the total body weight of all live animals in Bangladesh. The table shows that in comparison to the 2.2 million tons of meat actually supplied to consumers, the total live weights of the animals slaughtered is 3.4 million tons, and the total weight of the live herds in the country is 7.3 million tons (similar to the government estimate). Therefore, the DLS estimation of meat supply is more likely representative of the total body weight of the herds available for slaughter, but not on the actual meat available to consumers. The actual per capita consumption of meat in Bangladesh is 36.93 gr/day.

With about 10 million cattle slaughtered annually[13], over half of these, or about 6 million are slaughtered for the religious festival Eid al-Adha. During the rest of the year, beef consumption is lower. The large number of bulls slaughtered for this festival creates a seasonality aspect of the meat supply. For the months directly following the festival, consumers have a lot of meat left over from the festival, and so the demand for beef from butchers is greatly reduced. During these low demand months, slaughter facilities operate with much lower throughput. As mentioned, while religious conventions dictate that bulls be sacrificed during Eid al-Adha, during the rest of the year, the majority of the animals slaughtered are old cows which are no longer productively supplying milk.

Slaughtering six million bulls, as well as other animals, on a single day, far exceeds the capacity of all of the slaughter facilities in the country. On this day, slaughtering occurs in homesteads and on roadsides, by untrained individuals. As a result, the open disposal of animal waste in the streets poses challenges for public health and safety, as well as creating environmental hazards. Further, since the hides are removed by untrained hands, the resulting products prepared by the tannery industry are of lower quality. Further discussion of the challenge to tanneries, as well as the public health and environmental impacts, follow in the relevant sections.

With half of the cattle slaughtered for Eid al-Adha, the other half are slaughtered during the rest of the year. Considering only the beef consumed during the rest of the year, the proportion of beef in national meat consumption remains high, at 49%, while poultry consumption increases to 23%. Chicken is less expensive per kilogram than beef. Many consumers, particularly in rural and peri-urban areas, report consuming no beef except during the festival. Beef consumption is higher and more consistent in urban areas.

Table 16: Retail prices for beef

Category	Sold by wet market butchers (BDT/kg)	
	Rural	Urban
Meat (mostly with bone)	420-450	480-500
Offal	350-400	220-500
Stomach	200-250	250

Source: field surveys and interviews

Beef market segments, products, and customer preferences

Over 99% of the meat consumed in Bangladesh is purchased as fresh cuts at wet markets. Culturally, Bangladeshi people prefer to buy fresh meat at markets, and are suspicious of meat sold at supermarkets and other shops. Animals are slaughtered in the early morning hours, and butchers act as retailers to sell the meat. Meat with pieces of bone is the most popular, while the stomach and other offal are also consumed. Only about 30% of the cattle are slaughtered in Dhaka are killed in official slaughter facilities, and only about 20% in the other major cities, with few to none being slaughtered in official facilities in the peri-urban and rural areas. The other slaughtering occurs in unofficial and unregulated sites, without veterinarian supervision. Even in the official slaughter facilities, the conditions of slaughter prevent the preparation of uncontaminated, safe meat according to basic food safety standards.

Less than 1% of the beef consumed in the country is purchased at formal sector shops, supermarkets and restaurants. The one industrial meat processing company, Bengal Meat, operates the only modern slaughterhouse in the country, which reportedly slaughters about 35 cattle per day, for a total of less than 13,000 cattle annually. Other companies have attempted to compete in the elite consumer segment, but failed due to limited market demand. Bengal Meat, as well as other companies, also produce processed meat products, although the majority

[13] Other industry sources report that 11 million cattle are slaughtered, making the percent slaughtered during the festival, equal to 50%.

is chicken, supplied to fast food outlets. Select cuts of meat without bone, as well as meat with bone, are available at the few supermarkets in Dhaka. As there is no complete distribution cold chain in the country, Bengal Meat rents space in supermarkets, and has its own shops, to ensure control of its entire supply chain.

The complete list of cut and processed beef products available from the formal sector includes beef bacon, boneless, bone-in, brain, chilli fritz, chilli salami, beef crumble pizza topping, flank steak, frankfurter sausage, beef ham, head meat, heart, hump, Italian sausage, keema, kidney, knuckle, liver, meat ball, mince, mortadella, neck, osso-bucco, pastrami, pepperoni, prime rib, rib eye, rib set, rib steak, rump, salami, salami loaf, sausage, shank, brisket, butt fillet, Canadian beef bacon, cooked corn beef, eye of silverside, gravy beef, pepper roast beef, smoked roast beef, spleen, T-bone steak, tail, tenderloin, tongue, and topside. Certain products are noticeably absent from shops and supermarkets, including most canned meat products and jerky. The absence of these products does not represent a market gap, but rather the absence of demand, and underscores the population's preference for fresh meat.

Much of the population does not trust the products in supermarkets as they report not knowing when the animals were slaughtered, or whether the meat is safe. However, 3ADI+ research also revealed that consumers do not know the criteria which define safety in meat products. They are not aware of issues such as the overuse of medicines, such as antibiotics, or contamination from the slaughtering process in substandard facilities. The price of meat in supermarkets also dissuades the majority of the population from purchasing there.

Current trends and expected future market growth

Of the different livestock species, the buffalo herd is expanding at the slowest rate, while poultry is the fastest. Average CAGRs show the cattle herd growing at 0.63%, buffalo at 0.48%, sheep at 1.99%, goat at 0.64%, and poultry at 2.67%. The low growth rates reflect the high cull rates, with animals sent to slaughter. The poultry growth rate is highest due to the rapid production cycle and the high demand for chicken meat.[14]

These small growth rates, coupled with the human population growth rate of around 1%[15] means that the meat supply to the nation will remain relatively unchanged. In fact, as the human growth rate is slightly higher than the cattle growth rate, the meat supply will decrease minimally, from in 36.07 gr/day/capita in 2019, to 35.41 gr/day/capita in 2024 – if population growth rates, slaughter rates, and the live body weights of animals remain constant. The supply of beef will decrease slightly, from 23.35 gr/day/capita in 2019, to 22.93 gr/day/capita in 2024. Additionally, while prices for beef and other meats have been increasing, inflation-adjusted prices show that real prices have been in decline, in part signaling flagging market demand.[16]

Additionally, unlike in the dairy value chain, no major regional supply gaps exist relative to demand, in the different regions of the country. Although prices for beef range from 400 to 500 BDT/Kg across districts, the variation is related more to the difference between urban and rural locations, rather than any regional deficits. While beef prices at the butcher level vary by about 20% between the regions, the variation in the producer price of milk surpasses 100%. The average wet market beef price according to 3ADI+ surveys is 445 BDT/Kg. Cattle traders efficiently move live animals from rural and peri-urban areas with high supply, to urban areas with high demand, at low margins. Transporting live animals for beef consumption does not engender the same challenges as

[14] Currently the high cost of poultry feeds, compounded by the market demand for chicken meat reaching a saturation point, has led to economic sustainability challenges for poultry farmers. The industry is likely to undergo change or consolidation.

[15] The growth rate of the human population is gradually declining, falling from 1.19% in 2010, to 1.02% in 2018.

[16] Milk prices have overall been increasing year-by-year as well, while inflation adjusted prices show the milk price remaining level.

transporting perishable milk. Whereas regional gaps exist in milk availability, traders essentially eliminate the gap in the beef sector through trading in live animals.

Conclusions of the beef market analysis and implications

While milk production has increased rapidly over the last decade, the beef supply has grown at a more moderate rate. The stable beef supply represents an equilibrium situation, without gaps in demand. Whereas increasing urban middle-class growth and purchasing power would be expected to intensify demand for beef, the impact thus far has been restrained. Much of the new demand for meat is currently channeled to the poultry sector. Additionally, while meat eating is central to Bangladeshi culture, the country also has a strong vegetarian tradition.

The demand for bulls during Eid al-Adha is the most acute market pressure affecting the bull fattening sector. Only recently has Bangladesh produced a sufficient number of bulls to satisfy the Eid al-Adha demand. In the past, cattle smuggled from India made up for the gap in production. However, in recent years, smuggling has fallen from one or two million cattle annually, to around 300,000. These smuggled animals pose health risks and undermine Bangladeshi animal fattening businesses. However, the smuggled cattle have less impact now, on demand and overall market size.

In spite of the projected minimal decrease in the supply of meat as compared to the human population growth, the supply of cattle for beef could be influenced to gradually increase to meet the gradually increasing demand. Two factors, which could be bolstered by DLS and its national and international (UN) partners, would reinforce an increase in the supply of cattle for slaughter.

First, as mentioned, the high cull rate is motivated by the good returns that farmers earn on the sale of bulls and culled cows. If more cattle were born, while maintaining or increasing the cull rate of 40% annually, more cattle would be supplied to the slaughter markets. More cattle would be born if farmers reduce the calving cycle of their dairy cows. While on average, in the areas surveyed by 3ADI+, new calves are born every 15 months, best practices in farm management recommend a cycle of 12 months. By increasing both the birthing cycle and the cull rate, more animals would be available for consumption as beef, without increasing the already overwhelming cattle population densities, straining extension systems, or creating environmental challenges from the over-production of dung and GHGs in the form of methane emissions from animals.

Second, as DLS and its private sector partners continue to promote AI, and the development of higher yielding milk cows, the result will also be larger animals with more meat. Therefore, the supply of meat will increase, without altering the growth rate in terms of the number of cattle.

3.4 Core Value Chain

3.4.1 Inputs into core value chain

As analyzed previously, Bangladesh has seen a considerable increase in milk and meat production after decades of artificial insemination. The introduction of exotic breeds has significantly changed its production systems in most milk and bull-fattening zones. The improvement in breeds also requires adequate feed supply to ensure proper animal nutrition and outputs. However, the increase in feed cost pose a challenge to farmers, who has limited input market access and less capital, to make profits from cattle rearing. This section, therefore, mainly focuses on the improvements and constraints existing in breed selection and cattle feed supply.

3.4.1.1 Breeds and artificial insemination

Breeds found in the country

Most of the smallholder farmers in Bangladesh rear indigenous cow, which is called "Deshi" cow in local language. In the past, the local breed used to be qualified draught power, while currently, the animals have been raised mainly for dual proposes: milk and meat. The indigenous cow is featured by small size, low milk yield but good meat quality. One cow produces around 0.5-1.5 liter of milk per day, which barely brings any profits for smallholders. However, with red-colored skin, as well as soft and tender flesh, the bulls are popular for meat. In particular zones of Bangladesh, certain indigenous breeds have better performance, such as Red Chittagong Cattle, Pabna Cattle and Munshiganj Cow. Compared to Deshi cow, those breeds are larger in body size and better in milk production. For example, one Red Chittagong Cattle can produce 2-6 liter/day, while Pabna and Munshiganj cows can even reach approximately 10-12 liter/day[17].

To increase the milk and meat production, the government started to introduce some high yielding dairy breeds to the country. The most acceptant cows are tropical breeds from the sub-continent like Sahiwal and Sindhi, as well as temperate breeds such as Holstein-Frisian (HF) and Jersey. HF is one of the most productive breeds of the world and the body weight of a pure HF can be twice as much as Deshi cows. With an average of 20-26 liter per cow per day, HF is one of the best choices for artificial insemination purpose and widely promoted in most milk producing countries. Jersey was introduced in Bangladesh for the same reason but it's not widely applied as HF. Sahiwal and Red Sindhi are two common tropical breeds, originate in Pakistan and India. The skin color is generally light or dark red, which is close to Deshi cows. They show better performance in terms of milk production, with an average milk yield of 7.5-8 liters per cow per day and higher fat content (around 4.5%). These two breeds are highly preferred by Bangladeshi farmers for artificial insemination as the crossbreeds will not only produce more milk, but also can be sold as good quality meat.

HF cross and local breeds

Appropriateness of breeds for dairy and meat

Compared to the local breeds, the milk yield of the crossbreed is significantly higher. Currently there is no available National Breeding Act to regulate breed imports[18]. Farmers have little knowledge in terms of proper breeds and breeding service choices. The only guidance that the Government of Bangladesh has developed is the National Livestock Policy, published in 2007. Breed development is incorporated in this policy and meanwhile different breed strategies have been promoted to three targeting groups, depending on their management systems. For more commercialized farmers under intensive management system, 100% HF blood is promoted to maximum the milk production. Cows reared under semi-intensive system will start with 50% HF blood (Crossbreed: 50% HF and 50% Local) and semen of Sahiwal bulls. Regarding low input production system, indigenous cows will start being inseminated with Sahiwal and good performance local breeds, such as Pabna Cattle or Red Chittagong Cattle. The rationale behind such promotion strategy is depending on the affordability and capacity of farmers. A sudden change in animal breed and size requires more capital in feed, water, veterinary inputs as well as housing and

[17] Training Module on Good Dairy Farming Practice, Nurul Islam.

[18] National Livestock Policy (2007), retrieved from: http://old.dls.gov.bd/files/Livestock_Policy_Final.pdf.

other services. Due to a lack of experiences and finance, small-scale farmers may suffer losses if taking directly pure HF blood. Apart from HF and Sahiwal, specific programmes have been conducted to promote Jersey cross and buffalo cross, meanwhile good performance local breeds are specifically mentioned to be preserved.

Indeed, the crossbreeds have better milk yield and long lactation period which seems to be more profitable. A crossbreed cow with 50%HF and 50% local blood can produce 8 -12 liter of milk per day. Even though the average fat content decreases from 4-4.5% to 3-3.5%, the increase in output still largely improve the income of dairy farmers. Simultaneously, with larger body size, the feed consumption of HF cross has increased rapidly for the sake of acquiring enough nutrition and energy for body maintenance. Meanwhile, HF cross cannot quickly adapt to the sweltering and humid climatic conditions in the tropical zones. Their ability to resist disease and heat is weaker then local breeds. Without proper facilities installed and disease prevention measures, farmers would easily suffer huge losses from animal diseases and death.

Considering the options for milk and meat purpose, farmers have different preferences in terms of foreign breeds. In the primary and secondary milk zones, HF cross is highly appreciated. Certainly their high milk yield is mostly preferred, while farmers' better access to inputs and all necessary services further ensures the high outputs. In developing or non-milk zones where farmers still depend on selling calves or adult bulls for quick cash, tropical breeds like Sahiwal and Red Sindhi are more favorable. This is mainly because the crossbreed remain red-colored skin, which can be sold as "local" breed and considered as quality meat. Brahman, another exotic breed, is considered as a good option for fattening purpose. Brahman cross is mostly seen in areas where cattle trade activities are dynamic. Meanwhile, because of the huge consumption of meat, particularly during Eid, old dairy cows, buffaloes and cattle from illegal cross-border trade will also be sacrificed for meat purpose.

Table 17: Productivity of cattle breeds in existing system

Breed	Average daily milk yield (Litre/day)	Average lactating days	Annual milk yield (Litre/year)	Average body weight (kg)
Local breed	0.5-1.5	180	90-270	150-200
Local×25% HF	5	230	1150	278-280
Local×37.5% HF	7	245	1715	300-320
Local×50% HF	12	270	3240	340-360
Local×62.5% HF	15	280	4200	400-420
Local×Sahiwal	6	210	1260	340-360

Source: estimated by livestock experts, authors.

Artificial insemination and natural breeding

Artificial insemination (AI) is an efficient way to improve productivity and bring incomes to farmers. The Government of Bangladesh is currently running the Artificial Insemination Extension Programme with the aim of improving productivity. A number of Cattle Breeding Stations have been established to support the Programme at central (in Savar), regional (in Rajshahi) and district level to produce and distribute superior quality semen. From 2017 to 2018, around 3.8 million cows were inseminated[19]. With a significant penetration of AI services, the percentage of crossbreed reaches nearly 40% throughout the country. In a few milk zones, the percentage reaches 60% -75%. Particularly in certain peri-urban areas, the AI has achieved great success.

[19]https://mof.portal.gov.bd/sites/default/files/files/mof.portal.gov.bd/page/e8bc0eaa_463d_4cf9_b3be_26ab70a32a47/Ch-07%20%28English-2018%29.pdf

According to the 3ADI+ field survey, HF and Sahiwal are two breeds primarily being promoted by the District Livestock Offices (DLO) and Upazila Livestock Offices (ULO). There are several types of semen supplied to farmers, usually with 100%, 75%, 68.5% (or 62%) and 50% of HF blood and 100% of Sahiwal blood[20]. Sometimes Sahiwal semen runs out quickly because it is highly appreciated by farmers for its dual functions. In districts where bull fattening activities flourish, Brahman gene is promoted through Beef Cattle Development Project. Mature quickly, Brahman cross can bring a quick return that motivates bull-fattening farmers to reinvest in their businesses. Semen of good performance local breeds is also available, but only accounts for less than 5% of the total demand. The target for dairy crossbreed, in general, is around 80% according to DLS officers at the district level, as beyond this percentage, the cows would not be able to stand the environment and the humidity. As described previously, considering the potential burden for farmers, there are different policies for rural and urban areas. For urban areas where most farmers can afford extra feed and veterinary costs, 100% of exotic blood is promoted, while in rural areas, farmers in general start with 50%, 62% or 75%. However, this is not strictly followed and properly recorded in reality. According to the interviewed AI workers, 75%, 70% of HF blood and 30%, 100% of Sahiwal blood are promoted most frequently. There is a tendency that the focus of promoting crossbreed generally starts from the capital of district (Sadar area) and then spread to the surrounding rural areas, leading to local breeds are more aggregated in remoter areas.

In addition to artificial insemination, natural breeding is an alternative option, particularly in rural areas. Usually, natural insemination happens in cases that cows mate while grazing in open areas, or mate with the help of a particular inseminator. Farmers who prefer natural insemination service mostly because of its high conception rate, compared to AI (average 50%) and its low service cost. However, natural breeding may cause venereal diseases or inbreeding problem especially when bulls are limited in number in a particular area[21].Also, there is no particular control for breeds or percentage of foreign blood used for natural insemination, as no proper record is existing for this informal option.

As mentioned earlier, the conception rate of AI is considered low, on average about 50-60%. The underlying causes of this low rate are:

1) The technical capacity of AI workers. Many AI workers received minimal formal education and systematic training. Some only participate in a three-month training which can hardly meet the requirements. However, to ensure the success rate, the operation of the inseminators must be hygienic, accurate and skillful in order to prevent semen from being contaminated resulting in the decrease of its survival rate. Also, proper AI techniques should not cause additional physical injury during operation which may affect the delivery of cow calves afterwards.

2) Ability of cattle rearing farmers to correctly identify heat of their cows. Because of insufficient training, farmers often cannot accurately detect heat and identify the appropriate time for breeding. In most cases, farmers only call for individual services and choose the preferred breed without considering carefully the potential impacts. This requires careful daily monitoring of the herd and clear breeding records.

3) Animal nutrition. Cattle need special care in nutrition. Without adequate intake of some essential vitamins and minerals, they will not reach their full potential. However, in practice, farmers pay less attention on animal nutrition resulting in malnourishment of their cows, largely affecting the milk and meat production capacity as well as reproduction.

[20] Data collected from DLO.

[21] Training module on good dairy farming practice. Nurul Islam.

Artificial insemination delivery system

DLS provides liquid and frozen semen and distribute the services in district and upazilas. The services of DLS are usually delivered by District Artificial Insemination Centre (DAIC). There are in addition a total of 3,750 sub-centers and points to further support the delivery of the liquid semen. In general, the cost of frozen semen is higher because the quality can be only maintained in a suitable temperature, creating additional cost for storage facilities. AI workers and volunteers can purchase containers from distribution centers or AI points. According to the interviewees, the cost of one dose semen collected from DLS ranges from 30tk to 50tk, while the price of providing door-to-door AI services to farmers is about 200-300tk including semen and services as a whole package.

Even though DLS stores semen in each upazila office, there is still a huge gap in service delivery due to a shortage of human resources. DLS can only fulfil 30% -50% of the total demand. As a result, along with the AI programme conducted by the Government, many companies and non-government organizations are authorized to delivery AI services through their own projects.

Among all the AI providers, BRAC has achieved more outstanding results. BRAC established a Bull and Buck Station in Mymensigh in 2000 to produce frozen semen. Liquid nitrogen is being used for cryopreservation. The semen is then collected and distributed by its AI workers, who receive training from BRAC and often provide door-to-door services to farmers. They purchase semen from depots (70 in total) throughout the country. By 2015, 2,220 AI workers are able to provide services and 1.64 million cattle have been successfully inseminated[22]. The average purchasing price for one dose is 140tk, and the whole service package charges 205-250tk[23].

American dairy is also committed to breeding improvement and preservation. The company owns modern facilities and advanced research capacity in Bangladesh. The experts of American dairy have found out the best crossbreeds for smallholder farmers after years of experiments. The new crossbreed is moderate in size and feed consumption but with a significant increase in milk production. Similarly, the frozen semen is distributed by their own AI workers in targeting villages. At the same time, the tagging system is also widely brought into practice within the geographical scope of their service, contributing to a better traceable records for all the inseminated cows.

Besides the public sector and the leading companies, the number of NGO providing similar services is increasing. Their services are often applied in project areas or at village level. Companies and organizations that are authorized to provide artificial insemination services are well placed to fill the gap of public extension services. However, with a growing participation of various players, the service market becomes saturated and hard to control. The need of government regulations and monitoring on breed promotion seems to be crucial. Since farmers are free to choose cattle breed for AI without any record keeping, the consequences of receiving artificial insemination services randomly can be fatal to their businesses.

[22] (BRAC factsheet)

[23] BRAC Artificial Insemination: http://www.brac.net/brac-enterprises/item/879-brac-artificial-insemination

Table 18: Semen type delivered by DLS in selected districts

DISTRICT	TARGET	SEMEN AVAILABLE	% OF CROSSBREED (HF & SAHIWAL)	% OF LOCAL BREED
TANGAIL	80% HF cross	HF: 50%, 68.5%,75%,100% Sahiwal: 100% (limited amount) Brahma: 100%	80%	20%
SATKHIRA	70% HF cross	HF: 60%,75%, 100% Sahiwal*HF: 50%*50%	26%	74%
FENI	60% HF cross	HF: 50%, 100%	50%	50%
KUSHTIA	80% HF cross	HF: 50%, 62%, 75%, 100% Sahiwal: 100% (limited amount) Brahma: 100%	NA	NA
NATOR	(In line with national policy)	HF: 60%,60.2%,70%,75% Sahiwal:100%	75%	25%
DINAJPUR	(In line with national policy)	HF:62.5%,70%,75% Sahiwal:100% Jersey: 100%	20%	80%
SIRAJGONJ	70-80% HF cross	HF: 76% Sahiwal: 100% Sindhi: 100%	40%	60%

Source: 3ADI+ field survey – interviews with District Livestock Officers

3.4.1.2 Feedstuff

Feedstuff provides cattle with essential nutrients like protein, water, energy, vitamins and minerals, which are crucial for their health, growth and production. The possibility of success in cattle farming mostly depends on the quantity and quality of feed given to cattle. In Bangladesh, the biggest challenge in feed supply is the availability and cost, leading to a high production cost in cattle rearing. Farmers either pay less attention in quality feed supply, or pay high cost in purchasing feed that may put them at the risk of operating a loss. With feed making up around 70% of the cost of cattle and milk production, reductions in the cost of feed have a dramatic impact on farm profitability.

Feeding systems in Bangladesh

The majority of the smallholder farmers in Bangladesh still follow the conventional patterns. In general, three categories of cattle feeding systems are identified, varying from a grazing mode to a semi- or a complete intensive mode.

The first category, which is more common in rural areas with low-level development, is well-known as “kitchen farmers” who proceed no more than two indigenous breeds. They generally tether the cattle in the fields or on the roadside where the grass is accessible; or squat close to their house, feeding with household residues. The cattle reared under this grazing mode is usually under-nourished, with extremely low outputs. As a result, cattle rearing can barely bring any profits for kitchen farmers.

Another feeding system is mostly distributed in certain parts of the country where the river crosses the continent and separates the mainland from island chors. "Chor" is the local way of saying alluvial pasture land where farmers leave their cows grazing freely during non-raining seasons. The advantage of this feeding mode is that cattle can obtain rich nutrition from abundant and fresh grass. Meanwhile, the animals can move freely and unrestrainedly, which is more conducive to their growth. Farmers with access to island chars benefit from grazing their cattle for as much as six months per year. Once the chors are flooded and not available for grazing during rainy seasons, the mode will be switched to a more intensive feeding system.


Cows grazing in chor area

The third type can be found mostly in the developing zones or milk producing zones. Cows are reared in proper cowsheds and fed with green grass, dry straw and concentrates on a daily basis. Where appropriate, the intensive feeding system generally makes the whole milk and beef production more efficient. However, this mode also requires a lot of capital and technical expertise as it relies on imported feed (concentrates) and breed, heavy veterinary inputs and modern housing system. Currently in Bangladesh, only commercial farms can meet the requirements, accounting for less 15% of the total.

Cattle feed used in Bangladesh

Cattle requires different nutrients in support of keeping the body functioning properly. Feed generally provide cattle with six vital nutrients (water, protein, fat, carbohydrates, vitamins and minerals)[24] for body maintenance. In general, the feedstuffs for cattle have three main components, dry and green roughages, as well as concentrates. The green fodder, or green grass, contains water, minerals and vitamins which are essential for keeping cows in a healthy status. Dry roughages include straw, stover and hay, containing less moisture (10-15%) and the nutritive value is poor[25]. Concentrates are richer in total digestible nutrients (TDN) on dry matter basis, which provide energy and protein for cattle growth.

The most common green roughages in Bangladesh are fodder crops like maize and Napier Grass. At present, only 0.1% of the total cultivable land is used for fodder production while the majority is used for cereal crops[26]. This leads to a huge scarcity in green fodder supply. The increasing demand for fodder puts extra pressure on limited land resources. To solve the problem, the government has promoted certain low-cost high-yield grasses to fulfil the demand. The most representative grasses are Napier grass, Jumbo grass and Hybrid Napier, which can be harvested 6-8 times per year with annual yield of more than 40,000kg per acre. Particular types like Para grass and German grass can be grown in water logging conditions or marshy land, could be alternative options if cultivable land is not available. Production of high yielding green fodder by smallholder dairy farmers is the best method to reduce feeding costs, thus also increasing the chances that the farm will succeed in its project of generational up-breeding. The cost benefit comparison of different types of fodder will be included in Annex 3.

In flood affecting areas, rice straw or maize stover is used as replacements when there is a shortage of green fodder supply. However, due to its inadequate nutritive value, animals cannot source the same amount of

[24] Training module. Nurul Islam.
[25] Training module. Nurul Islam.
[26] M.T. Uddion & A.R.Dhar (2018). Socioeconomic analysis of hydroponic fodder production in selected areas of Bangladesh: prospects and challenges.

nutrition intake as green roughages provide. If dry roughages are the only source of feed, it is likely to cause malnutrition and lead to a sharp decrease in milk production.

With regards to concentrates, wheat bran, rice polish, oil cake, molasses are the primary ingredients in cattle feed. Concentrates are rich in energy and protein, which cannot be fully obtained from green or dry roughages. Farmers mostly make concentrate in their own way, by mixing purchased ingredients with kitchen residues or on-farm by-products. Due to a lack of relevant knowledge and high costs for ready-made concentrates, many farmers rarely or partially use concentrates to feed their cattle. Consequently, insufficient concentrates intake directly conducts to low milk production and lack of energy.

Ideally, farmers who handle the feeding practice perfectly should provide high quality feeds with proper amount and ration, and choose the right time of feeding. If a cow-calf gets enough nutrient intake from an early age, it will have better outputs once grown up. For instance, for a local breed with daily production of one liter, the milk production can increase up to 9 liter/day during lactating if it has been proper nourished after birth. This is mainly because the mammary forming of a calf starts from the third week, but often during that period, milk is taken for sale and no substitutes are available. As a consequence, calves cannot get proper nutrition which hinders the production potential when it grows up.

Challenges in green fodder supply

Because of its important role in providing necessary nutrients to cattle, the supply of green fodder becomes crucial for farmer. Feeding cattle sufficient amounts of green fodder throughout the year not only increases milk production and the fat content in the milk, but is also less expensive than increasing the quantity of concentrate feeds in the cow's diet, which is the alternative feeding method for cross-bred cows requiring high quality feed. To obtain sufficient green fodder, some farmers tend to grow on their own land. In this way, green fodder is more accessible and the supply is assured. In other cases when land is used for cultivating more profitable crops, fodder will be planted on the roadsides or the steep edges of the field. Apart from growing by farmers themselves, purchasing from local markets is an alternative option, particularly for landless cattle keepers.


Fodder market

To grow fodder, it is essential to take weather and land conditions into account, because those two factors will largely affect the choice of fodder and its growth. For example, in district like Sirajganj, fodder production is frequently affected by flood during monsoon. The farmland is totally water-logged and unable to grow any crops for several months. Therefore, milk production is often significantly reduced during this period and the price of green fodder increases sharply. With regard to land conditions, certain high-yield fodder, such as maize or Napier grass, are only suitable to be cultivated on high lands, which has greatly limited some lowland areas to get enough fodder supply.

According to the field research, the availability of green fodder has a huge impact on the seasonality of the milk production. The milk production reaches the highest point in winter in certain districts because their regular crop cycle (for example, Khustia and Natore). Instead of growing high-value crops, green fodder is more productive during winter season in those areas, contributing to an abundant supply. In some districts, seasonal weather patterns including flooding, prevent green fodder production all year. For the districts where green fodder is available all year long (e.g. Satkhira), there is no evident high or lean season. Farmers who grow fodder all year long generally can have 6 crop cycles, with an annually production of 2000-2300kg per acre[27]. The slight difference in milk production often depends on the lactation period of the cows. The price of fodder varies slightly from 2.5tk

[27] Calculated from the field survey.

to 5tk per kg in most areas. However, when there is a shortage in rainy seasons, the price can increase to 12tk per kg (for example in Sirajganj).

There has been a lot of work already on increasing production of green fodder. NGOs and DLS promote seeds of Napier grass and other varieties through programmes and provide training to farmers on how to take advantage of roadsides and available high lands. With such institutional support, a number of farmers who have fodder surplus have become commercial fodder suppliers and profit from fodder sales. The trend of fodder production will continue to expand, but compared to rice and maize, fodder production is less profitable therefore no transformation changes are expected.

Table 19: Cost benefit comparison of rice and green fodder production

Per acre per year	Rice	Green fodder
Sales Revenue		
Yield	1112.5	2000
Price	14	2.9
Total revenue	15575	5800
Production Costs		
Insecticide	216.86	380
Seed	230.7	408.9
Fertilizer	744.5	830
Irrigation	715	2711.5
Labour cost	7222.9	0
Total cost	9129.96	4330.4
Net return	6445.04	1469.6

Source: estimated from Md. Islam et al[28], field survey data

Straw and concentrate supply


Ingredients sold in the local market

Due to the geographical and climatic conditions of Bangladesh, the main crop cultivated in the country is rice. Rice straw is thus highly available as cattle feed. For farmers, straw is low-cost and easy to obtain and store. In absence of funds to buy concentrate, as well as of low availability of green fodder, rice straw is the primary choice to feed the animals. Untreated rice straw can reduce the hunger because of its low digestibility, but it has less moisture content and lower nutritional value compared to green fodder and concentrate. Cattle that only fed with rice straw generally show lower performance, such as low milk productivity and digestive diseases. Some techniques can be used to improve the nutritive value of rice straw, for example, when mixed with urea, water or molasses, the treated rice straw can provide more energy, protein and other essential nutrients to cattle. The price of dry straw remains under 4TK per kg in most time while in lean season, the price can increase up to 15TK per kg.

As for concentrates, in the major milk producing areas of Bangladesh, most trained and experienced dairy farmers know the importance of using concentrates. However, the concentrates of actual use varies depending on the availability of ingredients. To save cost, most farmers only buy ingredients in the local market and then mix them with some of the materials that they can get from their own farms or households. The most common ingredients

[28] Md. Zohurul Islam et al. (2017) Profitability and productivity of rice production in selected coastal area of Satkhira district in Bangladesh

for concentrates are wheat bran, rice polish, molasses, oil cake, etc. Those can be used as a supplement to green fodder to enrich cattle's protein and energy intake. Readymade concentrates are not so popular due to the high cost (32-40TK per kg), used for only 10% of cattle.

In fact, industrial feed companies show their strong presence in the country. Feed manufacturers produce value-added readymade feed and sell it locally. Even though poultry feed is always the focus and widely-used in the country, cattle feed is also available and usually distributed through dealers who purchase in bulk. Feed is the most expensive cost element of cattle rearing, which is generally considered to make up 70% of the production costs of milk production. Among all, concentrates in the most expensive element, accounting for 20-50% of the total feed cost, depending on the breeds (see an example below).

Table 20: Cost elements of cattle feeding in existing systems

Feed cost for traditional local breed system	
Concentrate feed for 1 cow at lactation period (1.5L/day) [Everyday 0.5kg concentrate for 180 days, Taka 28 per kg]	2520TK (17%)
Concentrate feed for 1 cow at dry period [Everyday 0.25kg concentrate for 185 days, Taka 28 per kg]	1260TK (8%)
Rice straw for 1 cow [Everyday 2kg for 365 days, Taka 6 per kg]	4380TK (30%)
Green roughage for 1 cow [Everyday 15kg for 365 days, Taka 1.2 per kg]	6570TK (45%)
Total	14730TK

Source: estimated from field survey and livestock experts

Feed cost for HF crossbred system	
Concentrate feed for 1 cow at lactation period (6.5L/day) [Everyday 3kg concentrate for 270 days, Taka 28 per kg]	22680TK (51%)
Concentrate feed for 1 cow at dry period [Everyday 1.5kg concentrate for 95 days, Taka 28 per kg]	4000TK (9%)
Rice straw for 1 cow [Everyday 4kg for 365 days, Taka 6 per kg]	8760TK (20%)
Green roughage for 1 cow [Everyday 20kg for 365 days, Taka 1.2 per kg]	8760TK (20%)
Total	44200TK

Source: estimated from field survey and livestock experts

While some of the ingredients of the concentrate feeds are produced locally, nearly all of them also need to be imported, as local production falls far short of the demand of the feed sector. For example, while Bangladesh imports soy, and maize recently surpassed wheat as the second most produced crop after rice (due to demand from the feed sector), the feed companies still import both crops. Local availability of oil cake and meat and bone meal (MBM) are also far insufficient for feed production. While most companies use a mix of locally procured and imported ingredients, the primary criteria defining the mix is not local availability, but price. When global prices dip below national prices, companies import large quantities of the ingredients of feed, such as maize and soy. This tendency is threatening the smaller feed companies, and enabling the larger companies to gain market share, as the smaller companies do not have the capital to import ingredients, when the price is low, to store them for use when prices are higher.

Proper ratio of cattle feed

A proper ratio of concentrate, dry and green roughage determines the performance of dairy cows. However, most farmers have very limited knowledge on this. The proper ratio of cattle feed should strictly adhere to cattle breed,

as well as theirs body weights and the amount of milk being produced. Otherwise, inadequate feed will largely affect the quantity of milk produced and the ability to resistant disease (see the comparison below).

Table 21: Comparison of crossbreed performance with different feed ratios

Feeding system	Concentrate for lactation period (kg per day)	Concentrate for dry period (kg per day)	Rice straw (kg per day)	Green roughage (kg per day)	Daily milk yield (litre per day)	Body weight (kg)
Existing system (Local *50%HF)	3	1.5	4	20	6.5	340-360
Improved system (Local * 50%HF)	4	2	5	30	8.5	420-450

*Estimated by authors

Silage and hay making

To face the challenges of feed supply, silage and hay making would be possible options to ensure the accessibility and availability of feed in lean seasons. By making silage, green fodder can be stored for longer time. During monsoon seasons, when fodder cultivation and grazing land is not available, silage can be a way out of this supply shortage. As a method of conserving green fodder with minimal nutrient loss, silage making has been introduced in various areas, the technology has not been adapted at scale. To make silage, green grass should be carefully selected and chopped into suitable size. All activities should be done in less time and necessary techniques should be applied to avoid grass deterioration and water pollution.

Hay is the dry form of green grasses and legumes, which has higher nutritional value than rice straw and can be stored for a long time without deterioration of its quality. Making hay also requires skillful manpower, otherwise essential nutrients will be lost during the preparation process. Meanwhile, hay's storage is very susceptible to the weather, especially on rainy days. Wet hay will easily generate mold and lead to poor nutrients intake by animals.

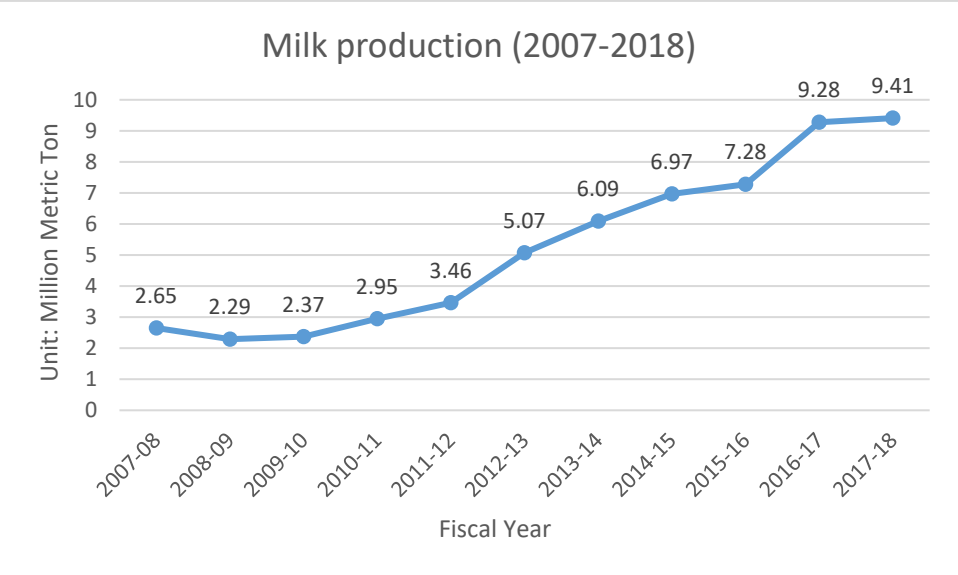
Currently there is very limited use of silage and hay in Bangladesh, not only due to a lack of knowledge and skills in handling and preparation, but also there is no excess green grass produced to store in a large quantity. Despite the challenges, as an alternative to addressing the shortage of forage supplies, these two methods have potential to improve the performance of primary production.

3.4.2 Primary production

3.4.2.1 Primary production for dairy farming

In Bangladesh, livestock is an indispensable component of the food system. As a traditionally agriculture-based country, small-scale farmers largely depend on agriculture production. Most of the farmers adopt a mixed farming system, by cultivating crops and rearing livestock at the same time. The livestock sub-sector plays a crucial role, as it contributes 1.66% of Gross Domestic Product (GDP) while also accounting for a 14.21% share in Agricultural GDP. The total population of cattle has reached 24 million with a total milk production of 9.3 million metric tons[29]. Even though the poverty share in Bangladesh decreases year by year, there is still 24.3% of the total population currently below the National Poverty Line[30]. Unlike with land-based agriculture, in which farmers own or rent fixed amounts of land and do not have much opportunity to increase their land ownership, cattle rearing would be a possible way for rural farmers to potentially escape poverty. Cattle can be used to produce milk and sold for meat, and generate valuable by-products such as cow manure, hides and blood. Nearly each rural household has at least one cow for either of those purposes. However, for a large number of cattle keepers, milk sales are not their main source of income due to the low productivity of their dairy cows. Also, limited land, high density of population, expensive feed cost and a lack of training, all constrain the development of dairy sub-sectors. The government of Bangladesh has therefore highlighted the importance of increasing milk production, which contributes to various production systems existing in parallel within the country.

Figure 12: Milk production in past decade



Source: Livestock Economy at a Glance (2017-18)

Production systems

Rural smallholders who own less than two indigenous cows seldom depend on the revenue of milk sales. Even though the local breed consumes less feed and has high disease resistance, its low milk production can barely bring farmers out of poverty. In the undeveloped system where mostly local cattle have been raised, the cost is

[29] Livestock Economy at a Glance (2015-2016).
[30] Asian Development Bank: Poverty in Bangladesh. https://www.adb.org/countries/bangladesh/poverty

almost zero. Cows are usually kept in unsanitary conditions without any proper shelter. Feed is not prepared in a scientific way, either using household scraps, or leaving cattle graze in the fields. Vaccinations and medicines are rarely used unless the cattle develop serious diseases. In such a way, the local breed is characterized by low milk productivity, producing 0.5-1.5 liters per day. This amount of milk cannot bring enough revenue and enable poor households to climb out of poverty. When farmers are in need of money, selling calves seems to be an optimal way to have a quick return.

Besides the very traditional rearing system, some farmers start to move towards a crossbreed system. In general, the first generation of HF cross can significantly increase the milk yield, up to 8-10 liters per cow per day. The more productive system provides sufficient income through milk sales to cover the feed and veterinary costs, so that farmers can reinvest as a profitable business. The crossbreed becomes even more valuable when it gives birth to heifers, as farmers can keep those to increase the yield.

However, this system cannot always generate better income. It is mainly due to the characteristics of crossbreeds. The crossbreed requires more cautious care than pure indigenous breeds. For example, HF cross consumes more feed, and needs better shelter with high roofs and ventilation. The optimal housing should also have separate troughs for water and feed and open spaces for walking. Meanwhile, the HF cross sometimes performs poorly in disease and heat resistance, which leads to more veterinary inputs, as well as regular bathing and cleaning. The high expenses pose great challenges to small-scale farmers who have limited savings to invest. For farmers who cannot afford the sharp increase in cost, selling calves is one option to cover. This solution will largely affect the expansion of farm yield, particularly when heifers are sold, preventing the family from using the multiplicative nature of livestock rearing to climb out of poverty.

The above-mentioned situations have brought deep thoughts on how the production system can be improved to truly benefit the dairy farmers. Farmers, especially smallholders with low income level, need to be cautious in the selection of exotic species for cattle. The adequate crossbreed should produce more milk without greatly increasing too much the input costs. Therefore, there are some alternative options as a transition towards a more advanced production system. For example, dairy farmers can start their first crossbreed generation with tropical breeds such as Sahiwal or Red Sindhi. These breeds are usually preferred in rural areas as they produced more milk and consume less feed. Meanwhile, the races from the sub-continent usually have better performance in terms of disease and heat resistance. Another reason for this popularity is because of the red-colored skin, of which the meat is preferred by consumers. As regards to HF cross, its productivity largely depends on the percentage of exotic blood. According to the semen that has been promoted by livestock offices, at district and upazila level, 50%, 62.5%, 65%, 75%, 80% and 100% of exotic blood is commonly promoted to the farmers. The purer the exotic blood is, the higher the chance that the crossbreeds are more productive.

Seasonality of milk production

The seasonal variation of milk production varies from one district to another. In general, the seasonality can be influenced by three different key factors:

1) Monsoons. Low land areas are easily affected by flooding during monsoons. The lands are water-logged and cannot be used to plant any crops or fodder. The shortage of animal feed leads to a sharp decrease in milk production. The most representative district of this category is Sirajganj where most of the grazing land is not available during monsoon season and the price of green fodder increases significantly due to its scarcity.

2) Crop cycles. As agriculture is the main pillar of rural household income, rural farmers tend to choose more profitable crops as their primary source of income. Therefore, green fodder is only grown during specific periods

when other crops are off season. From the survey, we notice that in Natore and Kushtia, winter is usually the peak season with the highest milk production. This is mainly because farmers grow fodder instead of other high-value crops during this period, which provides abundant fresh grass for dairy cows.

3) Lactating and dry period of dairy cows. For districts that are not affected by flood or crop cycles, the milk supply remains quite stable all year long. The slight variation is often because of the lactating and dry period of dairy cows. In general, the lactating days for crossbreed range from 230 to 280 days while the average for local breeds is 180 days. Therefore, the milk production slightly drops during the dry period but the total quantity remains more or less stable.

Table 22: Seasonal variation in milk production in selected districts

Area of milk production	Highest production	Medium production	Low production
Dinazpur	Nov,Dec, Jan, Feb, Mar, Apr,	May, June	Aug, Sep
Satkhira	Nov,Dec, Jan, Feb, Mar, Apr, May	June ,July	Aug, Sep, Oct
Tangail	Jan, Feb, Mar, Apr, May	June, July, Aug.	Sep, Oct.
Kushtia	Dec, Jan, Feb, Mar, Apr, May	Nov, Jun, Jul, Aug	Sep, Oct,
Kurigram	Nov,Dec, Jan, Feb, Mar, Apr, May	June, July, Aug	Sep, Oct,
Sirajgong	Dec, Jan, Feb, Mar, Apr, May	Nov, Jun, July	Aug, Sep, Oct.
Natore	Dec, Jan, Feb	July, Aug. Sep, Oct. Nov.	Mar, Aprl, May, June
Pabna	Nov,Dec, Jan, Feb, Mar, Apr, May	June, July, Aug.	Sep, Oct,
Chittagong	Nov,Dec, Jan, Feb, Mar,	Apr, May,June, July, Aug.	Sep, Oct,
Feni	Dec, Jan, Feb, Mar, Apr, May	Jun, July,	Aug, Sep, Oct. Nov.

Source: Field surveys, expert interviews.

3.4.2.2 Primary production for bull fattening

Bangladesh is a large meat-consuming country. According to the Department of Livestock Services, every year approximately 23 million ruminants, including cows, buffaloes, sheep and goats, are slaughtered for food. The slaughtered amount reaches nearly half only during Eid-ul-Azha. Among them, cows and buffaloes account for almost 40%. Since 2017, the country claimed to be self-sufficient in beef supply. However, the development level of professional and commercial bull fattening is still lagging. Most small-scale farmers do not do bull fattening. Bulls are usually fed with household scraps or dry straw without any particular treatments, which cannot result in much bulking. Smallholder farmers always sell bulls or old cows that no longer produce milk for meat purpose. And this happens mostly during Eid when there is peak demand for beef consumption. Unlike milk sales that can bring daily income, bull fattening is a longer process that hardly gains any immediate profit. Instead, to make sure that bulls gain enough weight, a huge amount of feed has to be provided for at least four months. Therefore, it requires farmers to have enough reserves or financial support in order to afford the whole fattening process. Moreover, women are the major labour in the household to take care of the cattle. It will be very difficult for women to manage those larger and stronger bulls. As a result, small-scale farmers generally tend to sell male calves instead of keeping them for fattening.

There are only a few middle and large-sized farmers completely involved in the bull fattening system. Indigenous breeds are the most favorable variety for meat. The places where bull fattening farms can be found are mostly distributed in non-milk zones and close to the Bangladesh - India border. Farms with a scale of less than 20 bulls

often have one fattening cycle per year, mainly targeting Qurbani to make maximum profit. Large farms with more than 50 bulls may reach four cycles per year. They often purchase male calves in bulk from cattle traders, and supply to large cattle markets in urban areas.

The business has been largely affected by the smuggling of bulls from India. Each year, thousands of Indian cattle have flooded into Bangladesh through informal cross-border trade before Eid-ul-Azha. The influx of Indian cattle often results in a decrease in price, significantly affecting local bull-fattening business. Farmers profit less than they expect during Eid thus constraining their reinvestment. Meanwhile, the situation might become worse if diseases like FMD brought from Indian cattle are spread among local breeds, as there are no efficient vaccines available.

Since Bangladesh gradually achieves self-sufficiency in meat, and with a much tighter control near the border, the number of smuggled cattle has decreased in recent years. Check points and stations have been constructed and imported animals are being examined.

3.4.3 Aggregation and intermediate trade

3.4.3.1 Milk collection

Milk collection is a critical value chain segments as it directly links producers to various buyers. Efficient and stable milk collection is a key to meeting the market demand and integrating more vulnerable households into the value chain. In Bangladesh, the milk collection systems are dynamic and diverse in different areas, depending on their development levels.

Traditional milk collector

Traditional milk collectors ("gosh") are key value chain actors who link rural dairy farmers to the next buyers. Individual collectors source milk from door to door, using three-wheeled vans to carry milk pots. No chilling tools or facilities are being used because they are usually able to deliver milk to chilling centers or processors within the time limit.

In general, milk collectors maintain a relatively stable relationship with farmers and buyers by oral agreements. Milk is collected twice per day (morning and evening), and is being delivered to the nearest collection centers, larger collectors or traditional processors. It's not a common practice for collectors to test milk purity and fat content, primarily because they are concerned more about quantity rather than quality. Meanwhile, due to a lack of simple and manageable tools, milk testing is not applicable for most collectors. Experienced collectors can judge whether the milk is adulterated by the color and taste. While some collectors tend to milk the cows by themselves to ensure its quality. However, these methods are not time-efficient and may risk of receiving milk with other additives that are not visible.

For areas that are yet penetrated by dairy companies, collectors supply more than 90% of sourced milk to local chhana and sweetmeat makers, whereas in large milk zones, milk collectors have diversified channels to sell their milk. However, since more and more collection centers have been set up and the milk collected is paid based on the fat content, the collectors who supply milk to the collection centers may suffer a big loss if the milk they purchase is adulterated.

Cooperatives and producer groups

- Milk Vita – cooperative model

In Bangladesh, milk cooperatives were formed under the Bangladesh Milk Producers Cooperative Union Limited (BMPCUL), which is well known by its brand name Milk Vita. BMPCUL was established by the government in 1973, initially for poverty alleviation, as well as ensuring a fair price and stable supply of milk. With the government's support, its social businesses have almost covered the entire country. Milk Vita now has 46 chilling plants covering 7 divisions, 41 districts and 137 upazilas. Under Milk Vita's cooperative network, 3084 primary cooperatives have been set up and supply milk on a daily basis.

With such a long history and strong presence, a large number of cooperatives have existed for more than 20 years and have maintained a trustful relationship among members. Each cooperative has a lead farmer who manages daily operations and generally has a close link with Milk Vita.

Milk cooperatives collect milk twice a day. Milk is being transported directly to Milk Vita's processing plants. The milk supplied by each cooperative is paid based on the average fat content and is recorded on a daily basis. Milk Vita offers is a little higher payment compared to other dairy companies. From the money received, each cooperative member will get a bonus of 1tk per liter for supplying milk. Part of the money will be used for transport cost, cooperative fund as well as a share for the government. The cooperative fund, also knowns as cattle development fund (0.65tk per liter), is set up to support big expenditures like veterinary services. Meanwhile, Milk Vita provides productivity-enhancement embedded services such as training on cattle health and feed supply, and rents grazing land in chars to farmers with a low rental price during no-flooded seasons (500tk for 6 months). However, constraints are envisioned because sometimes Milk Vita limits the demand, which leads to milk overproduction in certain districts. As a result, farmers have to diversify their channels to sell the surplus.

- Producer groups

Owing to the fact that the government pays high attention to increase domestic milk production, a growing number of NGO or social enterprises are currently involved in promoting dairy programmes in the countries. The targeted areas are mostly developing zones, not yet penetrated by industrial companies on a large scale. NGOs organize rural farmers into various producer groups and develop their capacities to increase milk sales income.

Hence, awareness raising, capacity building and market access have become the main focuses of the existing dairy development programmes. For example, lead farmers of the groups receive training from NGOs and then teach their members the more advanced dairy farming practices. The practices generally include housing system, animal feeding, use of chopping machines, animal diseases identification, etc. More job opportunities have been created under the framework of producer groups. For example, in Solidaridad's model, besides group members, there will be community livestock workers who mainly give primary animal health care and nutrition advisers (women) who provides nutritional advice, particularly to women and children. As a result, more youth and women can participate in the production activities and receive a fair income from providing services. Meanwhile, by linking with various types of buyers, producer groups can diversify their channels to mitigate the risk.


Women producer group

Under this model, more individual entrepreneurs are engaging in input and service provision with the support of NGOs. In areas where inputs are difficult to access, leader farmers serve their groups through selling feed, medicines and other necessary inputs to the group members. Some input shops are open next to the collection centers where farmers can easily purchase after selling the milk. In addition, women entrepreneurs are increasing in number, gradually empowering women's role in dairy business.

- Company-owned milk collection centers

To expand the milk market, lead dairy companies like PRAN and Aarong Dairy have set up a considerable number of village milk collection centers (VMCC) in major milk zones. A collection center is generally equipped with chilling tanks, a mini laboratory and a weighing machine. Milk is collected from farmers or producer groups twice per day. Lab technicians working in the VMCC test the milk content by using a digital testing machine, lactometer or centrifuge. Suppliers receive payment based on the fat content of their milk. Companies send chilling trucks to collect milk from each collection center and then transport to their manufacturing plants or hubs for further processing. Such companies have been witnessed a rapid expansion by owning immense investment capital and offering fair prices, embedded services and stable demand, attracting various types of supplier. In spite of this, only the farmers in milk zones benefit more from these collection centers, because these companies tend to choose areas with relatively high levels of development and have better road conditions.

More and more small and medium-sized enterprises are emerging in dairy industry. The owners of those enterprises usually have one or more collection points which have similar functions as the company-owned ones. However most of the entrepreneurs are existing in the areas where the leading companies have not yet penetrated or have switched their locations. Milk, once reached the collection points, is immediately chilled or processed into pasteurized or flavored milk. Then the processed products will be sold to the town or city centers. Some entrepreneurs also manage sweetmeat factories. Hence, milk collected from the center will directly supply to the factories for making curd, chhana, and ghee. In general, the small-scale milk collection and processing centers produce limited varieties of products. Despite of this, the owners usually have close relationships with villagers to ensure a stable milk supply due to the fact that most of them come from the local community.

PRAN VMCC – Milk test

PRAN VMCC – Record keeping

Chilling facility

3.4.3.2 Cattle trade

The trade of fattening bulls mostly depends on cattle traders. Apart from being sold directly to butchers, farmers sell bulls to small or large-sized traders. The trade activities are largely aggregated in the districts which are close to border and certain peri-urban areas. Traders source bulls from individual farmers and then transport and sell these bulls in urban cities like Dhaka, Chittagong, etc. There are two types of cattle trader. One conducts trade activities more frequently (more than 200 times per year) with relatively limited number for each batch (2-5 bulls per time). While the other only sells when the collected bulls reach a certain number (>20), mainly targeting Qurbani. Local breeds are highly preferred by traders (> 90%), followed by Sahiwal cross and buffalo. Old dairy cows are often sold for meat as well.

Nearly 50% of the cattle have been traded every year during Qurbani. The sale price of one bull is 5,000 – 20,000 BDT higher in Qurbani than normal periods, depending on the animal weight. Because traders are generally not

involved in bull fattening, the cattle are usually kept for less than one week. Otherwise there will be additional feed cost of 110-140tk per day per animal, greatly affecting their profits. According to the research, traders do not seem to be making big margins during Qurbani because the purchasing price increases at the same time. Additionally, a huge amount of Indian cattle is rushed into Bangladeshi cattle market, decreasing the price of local breeds. Transport and labour costs are two additional key cost elements in cattle trading. Meanwhile, sometimes cattle traders have to suffer losses because of animal death or diseases when being transported to urban markets from a long distance.

3.4.4 Milk processing

3.4.4.1 Traditional processors

Sweetmeats, a traditional food in Bangladesh, occupy an important place in the diet of Bengalis. Every year a large sum of sweets are consumed by households during all types of domestic ceremonies, national festivals and important events such as the celebration of examinations, weddings, Eid, Puja, etc. representing best wishes and good will. The common dairy products available in this country could be categorized in different ways, such as:

- Fat rich dairy products: Cream, butter, Ghee, Ice cream etc.
- Protein rich dairy products: Chhana, Ponir, Cheese, powdered milk etc.
- Fermented dairy products: Dahi (curd), Lassi, Lavan, yoghurt drinks etc.
- Indigenous sweetmeats: Rasogolla, Rasomalai, Chamcham, Kalojam, Malaikari, Peda, Danadar, Rajvog, Kachhagolla, Rasakadam, Lalmon, Gur sandesh etc.

Milk is the main raw material for making traditional sweets, resulting in nearly 70% of the total milk supplied to this traditional channel. Traditional processors are divided into two types. The first type is what we know as intermediate products processors. They source milk to make chhana, curd, cream and ghee (butter oil). Chhana is extracted from raw milk and served as a key ingredient for most of the indigenous sweetmeats. Processors supply chhana to sweetmeat shops or factories, mostly in peri-urban and urban areas, for further processing meanwhile they sell ghee or curd directly to consumers. The second type is the processors for final products, known as sweetmeat makers. They usually own sweetmeat shops (sometimes with processing areas in the backyard) and directly sell the final products to rural and urban consumers. But if milk can be easily sourced from their own district, the sweetmeat makers generally make chhana on their own to reduce additional production costs.

The main suppliers of milk are farmers and milk collectors. The average prices of sourcing milk is around 41 to 44 BDT/L. No formal contract is signed between suppliers and processors. The most common way is an oral agreement on a regular payment on the basis of volume. As sweetmeat making is a profitable business overall, so processors in general re-invest in their businesses with own finance. The revenue is also enough to afford daily milk purchasing. Universally, the processors recognize the importance of fat content, but clash on how to measure. The 3ADI+ interviews reveal that in most cases, traditional processors judge milk fat content and purity based on years of experiences (visually or by tasting). Some of them use a cream separator machine to identify the fat content even though time-consuming. Very few use a lactometer to test the milk. In this way, sweetmeat makers have a high chance to receive adulterated milk resulting in a low quantity of chhana and ghee produced and subsequently low quality sweets.

The use of powdered milk in traditional processing is directly affected by the seasonality of the raw milk supply. In general the peak season for sweetmeats is during winter when the milk supply is relatively stable. For certain events occurring during the low season of milk supply, powdered milk might be used to fill the supply gap. The market for sweetmeats is more or less saturated which gives most of the sweetmeat makers have no incentive to expand their businesses despite having the ability to do so.

A major concern of traditional processing is food safety. Due to a lack of regulation and low awareness regarding hygienic practices, the sweetmeats are frequently contaminated and may cause foodborne diseases. Sweetmeats are usually made manually with minimum equipment required (saucepans, basined tub, etc.). Most of the equipment is reused for three to four years. According to the sweetmeat makers interviewed, refrigeration is used only for curd while other products are kept at normal temperature. In sweet shops, products are displayed in transparent shelves. A few shops use food preservative film to cover the food but, in most cases, sweets are exposed to the air which can easily attract insects.

3.4.4.2 Industrial leading dairy companies

As mentioned above, a few leading companies, such as Milk Vita, PRAN, BRAC Dairy, Aftab, Akij, Rangpur Dairy, etc., have their own marketing channels from collection and processing to retailing. These companies often set up processing plants either close to the milk zones to ensure a stable milk supply, or near urban areas to approach consumers. The biggest processing factory of Milk Vita is at Baghabarighat in Sirajganj (major milk zone), which has a capacity of 135,000 liters per day. Milk is pasteurized in the factory and made into various products like ghee and powdered milk. Part of the pasteurized milk is sent to the factory near Dhaka to produce short shelf-life products, such as curd, ice cream and packaged flavored milk. PRAN has 5 dairy hubs linked with 100 VMCCs. Meanwhile BRAC dairy has 101 chilling centers with a daily capacity of 170,000 and 24% of the market share. Value-added products have been produced and sold to the market to fulfil diversified demand: cheese, butter, yogurt, UHT and pasteurized milk, ghee, etc. These three companies account for 80% of the market share among all private dairy enterprises.

Some of the above-mentioned companies are also involved in the import of powdered milk. They mostly repack and resell it within the market. A few international dairy companies such as Dano and Nestle have also set up their repackaging units in Bangladesh.

Table 23: Major industrial dairies in Bangladesh

Processing companies	Average milk collection (,000 litres/day)	Market share (%)
BMPCUL(Milk-Vita)	260	40.44
BRAC dairy (Aarong)	160	24.06
Pran dairy	160	24.06
Farm fresh	15	2.33
Amomilk	5	0.78
Rangpur dairy	7	1.09
Ultra Tec	5	0.78
Ultra Shelaida dairy	8	1.24

Aftab dairy	8	1.24
Day fresh	4	0.62
Grameen/CLDDP	7	1.09
Grammen-Danone	1	0.16
Rangpur dairy	8	1.24
Dhaka prime	2	0.31
Savar dairy	3	0.47

Source: estimated by national experts

3.4.4.3 Small-scale dairy businesses

In major milk zones, the market is penetrated and seized to a large extent by big companies. A few small and medium-sized dairy entrepreneurs are emerging but are still limited in number. It can be difficult for them to compete with the major dairy players who source milk in large quantities and offer embedded services. Therefore, the majority of these businesses are located in developing zones where the leading companies have not yet penetrated or relocated their chilling plants.

Generally, small-scale dairy processing is a family business. Dairy farmers who could not access the milk market previously, or are afraid of big companies shutting down their plants, tend to supply part or all of their milk to those individual businesses. According to the field survey, the number of chilling plants owned by individual entrepreneurs range from one to nine, with a minimum capacity of 4,000 liters per day. Commonly the chilling plants are equipped with chilling, processing and packaging facilities. They produce certain basic value-added products such as packaged pasteurized milk and flavored milk, mainly targeting urban markets. A few entrepreneurs are involved in milk collection because they also own sweetmeat factories. For them, to collect milk locally can both reduce its production cost for sweetmeat processing and generate extra revenue.

The comparative advantage of those small-scale businesses is their lower production cost compared to large companies, because they have less hired labour and can be flexible to adjust their business strategies. Meanwhile, they manage a close relationship with multiple dealers and traders to diversify their distribution channels. For example, one company interviewed indicated that they worked with around 85 dealers and finally delivered to hundreds of retail shops. Besides dealers, they also supply raw milk to companies like PRAN and other sweetmeat or ice cream companies for further processing. Dealers also play an important role as a market information point by informing the small dairy plants how much milk will be needed one day ahead.

The small-scale businesses usually provide products of good quality to keep their customer's loyalty to the brands and maintain a stable market demand. The freshness, punctual delivery and good taste are valued by consumers. However, one of the biggest challenges for them is road conditions. It happens sometimes that due to road congestion, milk cannot be delivered to dealers on time, which is at high risk of being refused. The transport element is a key concern as with poor road conditions, it takes longer to reach the next station, meaning increasing fuel expenses. Meanwhile, the entrepreneurs are hesitant in taking loans from the banks to support their businesses. As if the loan is not repaid, the whole business would collapse.

3.4.4.4 Other industrial processors – sweetmeat and ice cream companies

3.4.5 Meat slaughtering and processing

3.4.5.1 Meat slaughtering and butchering

The demand for beef in Bangladesh is increasing. During Eid, the number of cattle slaughtered accounts for more than 55% of the annual total. Meat products, particularly bovine meat products, are an important part of people's

daily balanced diet. Therefore, the processing of meat directly affects nutrient intake and the food safety of the whole population. The most popular and preferable meat is from local bulls, but sometimes buffaloes and old dairy cows are being sold as well. Urban and rural butchers purchase live animals directly from farmers or nearby markets.

Slaughterhouses cannot be found everywhere in the country. More than 80% animals are slaughtered outside the slaughterhouses of city government with very poor means of meat safety. The rest of the animals are being slaughtered inside the slaughterhouses managed by local government. In Bangladesh, animals are slaughtered using the Halal method, by a munshi or imam of a mosque. Bleeding is performed in the drainage pit or ground. Flaying of cattle is done on the ground with sharp knives. Cows or buffaloes are first hit on the ground and cut by their throats to dry the blood. Then the skin is removed from the body. Butchers use buckets filled with water to wash the meat and clean the blood-stained floor. The blood of the animal is discharged directly into the sewer through a groove. Animal waste (such as the stomach or other organs) is often thrown directly onto the ground, mixed with hides and uncleaned blood, or thrown directly into nearby garbage dumps.

Most of the slaughterhouses are lacking basic amenities such as light, ventilation and water. Due to the scarcity of water, butchers cannot wash carcasses and clean slaughterhouses properly. They often clean carcasses manually carrying water in a bucket. They clean the stomach in the pond resulting in huge water contamination. The slaughtering and carcass-dressing processes are performed in open areas in highly unhygienic conditions and the meat is sold with little or no veterinary inspection. Carcasses are prepared in unhygienic conditions in local slaughterhouses. In rural and urban areas, towns and even in cities, the slaughtering of animals is still done by unauthorized butchers in fields, bushes, backyards or roads, where killed animals are eviscerated and dressed. In the case of goats, it is usually performed by hanging. Blood, ruminal and intestinal contents are either left where the slaughter has taken place or washed down to drain which eventually ends up in a pond or a watercourse.

In Bangladesh, there is no organized system of animal slaughter facilities in terms of lairage, flaying of carcasses, carcass washing, meat inspection, etc. Inside Dhaka, there are only 3-4 slaughterhouses in operation, managed by the City Corporation. Some are mainly served for Qurbani and some are now under construction to be upgraded. However, in general, these slaughterhouses are largely far beyond the demand. Every day around 500-700 cows are slaughtered in Dhaka city but only 200-300 are slaughtered inside an abattoir. In a few slaughterhouses, the city corporation is mainly in charge of the waste treatment. Due to a lack of enforcement of the Slaughtering Act, food animals of different ages are killed indiscriminately without giving due consideration to the microbiology or the hygienic quality status of meat supply to consumers which may lead to potential health hazards. Butchers are not trained to manage by products in the slaughterhouses. They flay hides in a traditional method with a sharp knife which causes damage to the hide during the operation. Thus, the price of hides decreases by up to 15%.

The slaughterhouses, such as the ones near Krishi Market and Mirpur 11 market, are equipped with very simple facilities, such as water pipes or sinks and buckets for cleaning, hooks for hanging meat and pens for tying animals. Butchers pay around 50tk to use all the facilities. However, the overall conditions are difficult to meet hygienic standards, and the pre- and post-slaughtering inspections are almost none existing. After slaughtering, fresh meat is carried and transported by rickshaws to the nearby markets. Most of the butchers are not willing to come to the slaughterhouses because there is no suitable means of transportation and the closest one is still a long distance away. Moreover, the butchers who need to supply meat directly to hotels and restaurants lack refrigeration equipment to keep its freshness. The slaughtering situation even becomes more unmanageable each year during Eid as large amounts of cattle are sacrificed on the streets or at any convenient open spaces all over the country. The blood of animals runs down the street and huge quantities of animal waste are created and cannot be treated properly.

3.4.5.2 Industrial processing

Meat processing in industrial plants is a very recent addition to the food processing industry in Bangladesh. Bengal Meat Processing Industries, situated in Sathia (Pabna District, Bangladesh) are the only modern beef and mutton processing facility in operation. Combined, these facilities process less than one percent of total Bangladeshi meat production. The processing capacity of Bengal Meat is 6000-8000 cattle, 50,000 to 70,000 goats and 1,800,000 to 2,000,000 chickens per year[31]. They do, however, process meat into ready-to-cook nuggets, sausages, and other prepared products. Bengal Meat used to export meat but since 2014 the export failed due to its low-price competitiveness. The company then shifted its attention to the domestic market and currently only keeps 10% of total sales targeting oversea markets, such as Maldives, Qatar and UAE. Cattle slaughtered in modern slaughterhouses, then processed and packed directly in factories, is finally marketed through fast food shops, superstores and convenience stores. Regarding the geographical dispersion, Bengal Meat targets 70% in urban and 30% in rural areas.

The biggest challenge for industrial processing is the difficulty in reducing production cost. High duty fees constrain the company to invest more capital to purchase modern facilities like sausage filler, smoke houses, ice flake machines, MAP packaging systems, etc. Meanwhile the high rates for electricity creates additional costs. Due to its high production costs, the sale price is much higher compared to the raw meat in wet markets. Therefore, the targeted consumers are often limited to the middle and upper classes, those with higher income.

3.4.6 By-products treatment

3.4.6.1 Bone collection

Cattle bone is an important by-product of the beef value chain. Bone is treated in different ways. In general, fresh cuts with bones are preferred by consumers. While bone residues are usually collected by bone collectors. Most bones are sourced from wet markets, particularly from butchers or meat-based street food sellers. In urban and peri-urban areas where markets are less isolated or larger, almost 100% of bones are collected. While in remote and informal slaughtering areas, there is no efficient collection system existing.

For small bone collectors, the revenue from bone collection is not usually their primary source of income, but rather a part-time occupation. They gather bones in the wet markets or slaughtering areas, stock in bags and then deliver to larger bone collectors. The peak period of the bone collection is the Eid when a large number of is cattle sacrificed. Bones collected during Eid accounts for nearly 60% of the total amount of a year. The price of the bones remains stable while the process is tedious. Collectors sometimes have to collect remains from dumps and dry the bones for a few days before delivering to the next buyer. Moreover, it is difficult to find a place for storage. After selling to factories, bones are collectively chopped to uniformed sizes. All chopped bones are sold to processing companies, such as Global Capsule where bones are made into gelatin and capsules. The final products finally flow to both national and international markets.

3.4.6.2 Blood collection

In Bangladesh, bovine blood is usually being wasted. Whether in wet markets or slaughter slabs, the existence of mechanisms or facilities for blood collection are close to zero. In fact, blood is an important by-product with multiple usages. Dried blood meal can be used as fertilizer. Blood can be added to livestock feed as a protein source, and can also be used in the Food or Medicine industries. The only company that actually collects blood is Bengal Meat. At present, there is a lack of awareness and no supporting services in the country. Despite this huge gap, Bangladesh still has great potential to explore cattle blood collection.

[31] Data comes from the interview with Bengal Meat

3.4.6.3 Hides treatment

According to the Bangladesh Tanners Association, the country produces 220 million square feet (about 20 million square meters) of hide every year, 64.82% of which is cowhide, 2.25% buffalo hide and 1.2% sheepskin. More than half of it is procured from animals sacrificed during the Eid-ul-Azha festival. Another survey says about 16.5 million pieces of hides are collected each year in this country.

Given the fact that the hides of local cows and goats (Black Bengal Goat) are of high quality despite its size, Bangladesh is famous for its export of hides and leather products. Being the upstream segment of tanning and leather industry, hide collectors are the key actors of this by-product value chain. There is a wide range of hide collectors in different sizes. The small hide collectors generally source hides from households, nearby wet markets or slaughter slabs, while the large collectors have huge capital to purchase hides from small collectors or markets, and supply directly to the tanneries. The supply of hide is stable all year round, with 40%-50% collected specifically during the Eid festival.

In urban areas, almost all the hides are collected. According to the field research in the Krishi Market slaughterhouse inside Dhaka city, cattle hides and offal are thrown directly to the ground after slaughtering, mixed with other waste and blood. The practices of slaughtering also brings a new issue in terms of hide quality. Hides that are suitable for further processing should not have too many holes. However, cattle hide removal is always done manually, without using any professional tools or machines. Considering the technical level of slaughter, sometimes hides are destroyed by knives which cannot meet the requirement. This phenomenon is quite common during Eid when many unskilled people are also engaged in slaughtering activities. In addition, before delivering to tanneries, hides should be stored and preserved by salt or other preservatives for a while, varying from seven to twenty days. Therefore, the preservation technique of hide collectors also largely affects its quality. Other characteristics such as color, texture, size and length are also carefully considered by hide collectors.

Besides the challenges in quality, the relocation of tanneries from Hazaribagh to Savar has had a significant impact on the hide price. Before all the tanneries in the country shifted to Savar, the hide price could reach 2,000 to 2,500 BDT per piece. But currently, the price has dropped sharply to 500-600 BDT. Such a decrease in price is mainly due to the high shifting cost and low outputs for tanneries to move from one place to another, so they limit their demands. As a result, massive stock is unused but the number of cattle slaughtered increases, which leads to a mismatch in supply and demand.

3.4.6.4 Tanning industry

Bangladesh has its own strengths in developing the tanning industry because of abundant labour forces and raw materials. The country possesses a total of 55 million livestock including cattle, goats, sheep and buffalo. Such a huge number of resources contribute to a rapid growth in tanning and the leather industry. Though Bangladesh was exporting only wet blue leather and crust leather till 1990, more than 200 tanneries have started processing and exporting finished leathers since then. In spite of that, problems are emerging. In Bangladesh, inadequate supplies of quality raw hides and skins, availability of both quality and quantity of workers and the low adoption of appropriate technology pose a concern to the industry and affect its productivity and cost of production adversely.

Hazaribagh, a populated area in Dhaka, was once the center of tanneries. Inside tanneries, tanners use chemicals to process the skins and hides with their bare hands and feet, turning them into a blue color.

After a journey of 70 years, the tannery industries were shifted to new tannery estate, Savar, from Hazaribagh in 2017. To establish an environmentally sustainable sector, the government initiated CETP, Chrome recovery units, water treatment plants and central dumping zones for solid waste and other infrastructures that are operating

right now. Already 155 units of tanneries are distributed plots according to capacity of production as well as other issues and 105 units have started production under the new set up.

Around 220 tanneries (Hazaribagh) shifted to 155 tannery plots at Savar. Some other units are located in Gazipur, Chattogram, Jashor and Khulna. Recent statistics show that leather, leather goods and the footwear sector have about 3.54% [32] (Leather 0.67%, Leather goods 1.33%, and footwear 1.54%) growth. Bangladesh has a long established tanning industry which produces around 1.13%[33] of the world's leather from a local supply of raw materials. The average value addition in this sector is 85%. The global leather market is worth USD 215 billion, where Bangladesh accounts for only 0.5%[34]. In FY 14-15 local investment in the leather sector was only 0.92%[35]. Bangladesh leather industry aims to accelerate export growth to USD 5 billion[36] within 5 years. The Bangladesh exported USD 311[37] million in 2015, almost equal to crust (USD 138 million) and finished (USD 137 million) and imported raw hide, skins and leather of USD 147 million from international markets. Taiwan, Vietnam and Italy are the leading sources for finished and un-finished leather, whereas Hong Kong, South Korea, China and Italy are the leading destinations of Bangladeshi crust and finished leather.

3.4.7 Wholesale and retail distribution

The distribution segment concerns mostly the output of the industrial dairy or meat processors, which represent only small parts of the market. Supermarkets are emerging in big cities, but are not widely preferred by consumers, particularly for meat. Compared to processed bovine products, processed dairy products are distributed in more diversified forms.

3.4.7.1 Distribution and retail channel for milk and dairy products

The retail of milk and traditional processed products in rural areas is very much direct. Consumers can easily obtain the raw milk from their own cattle or purchase in local markets. Traditional processors sell sweets directly from their own stores or selling points attached to restaurants. The products are usually sold with paper-made packaging and kept for a maximum of 3 days. Refrigeration is only used for curd if it cannot be sold within the same day.

A complete distribution and retail system is essential for industrial processors. Whether SMEs or leading dairy companies, they often have specific channels to distribute the products. Some companies and SMES work mainly through independent distributors targeting a particular territory. The distributors collect the products either from the processing factory, or from their own receiving sites. Products are packaged by dairy companies and transported by refrigerated trucks, and finally delivered to retail points or directly to consumers by order.

With regards to large dairy companies like PRAN, Milk Vita or BRAC dairy, they have their own distribution channels with complete cool chain. Take PRAN as an example, refrigerated trucks load processed products from PRAN's processing plants, and deliver to supermarkets (in urban areas) and its own retail shops. For industrial sweet companies, such as Rosh, the processing factory is located in the periphery zones near Dhaka and its own retail stores can be found in most parts of the city.

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[32] EPB Bangladesh (Status report 2017,36th international footwear conference, Dhaka)
[33] Sector based need assessment, Business promotion council, Leather sector by BFTI, 2016
[34] Prospects Of Bangladesh Leather Industry: Farm To Fashion Products
lfmeab.org/images/report/Prospects_of_Bangladesh_leather_industry.pdf
[35] Prospects Of Bangladesh Leather Industry: Farm To Fashion Products
[36] Investment Prospects in Bangladesh Leather Sector-LFMEAB
[37] 13ITC (2017) trade record

3.4.7.2 Distribution and retail channel for meat and by-products

Bovine products are distributed through different channels, such as selling points in wet markets, supermarkets, restaurants and hotels. Locally produced bovine products are highly accepted by consumers. 96% of the consumers interviewed showed their preference of purchasing meat in wet markets, because they are easy to access and the meat is considered as fresh. Very few purchase from supermarkets or hypermarkets. The majority of the people purchase meat from traditional meat shops, where butchers slaughter few animals for the sale of meat throughout the day.

The survey shows that in Sadar (center) of a district or upazila, a butcher section can be found inside big wet markets, where butchers sit in a row selling meat. While outside Sadar, it's more common to see roadside butchers in village markets. The wet markets and roadside butchers sell around 80% of all retailed meat. Compared to normal cities, large urban cities have more wet markets where consumers have various options. With such huge demand, the stable supply of cattle is essential. As a result, urban butchers either have direct suppliers, or are close to a cattle trading market. For instance, there is a big cattle market in Korafuli, right outside Chittagong. From there butchers can purchase in bulk. Meat is marketed from the retail meat shops in village/municipalities markets and the metro town, maintaining very minimal hygiene conditions within the prevailing capacity. Due to public unawareness and minimal enforcement of laws, consumers often buy inferior quality meat with the risk of severe health hazards.

As processed bovine products is marginalized in the national market, only Bengal Meat has its own distribution channel for value added products. All products produced by Bengal Meat are sold through its retail gourmet butcher shops and butcher section in supermarkets, or directly supplied to restaurants, hotels and catering centers. Meanwhile, Bengal Meat is also trying E-business to meet the special demand during religious festivals. Bengal Meat has launched online Qurbani services which generally start one week before Qurbani. A list of cattle with detailed information is published on the website. Customers can book preferred cattle and then live cattle will be directly delivered to the customer's home. Additional services like slaughtering and packing are also included in the whole service package.

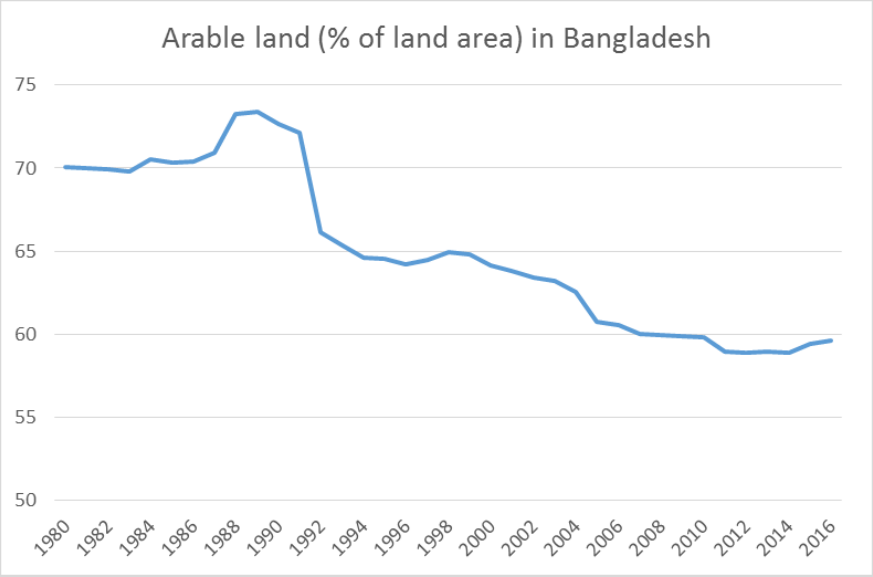
3.5 Extended value chain

3.5.1 Access to land

With a high density of population, Bangladesh is under the pressure of having adequate arable land to feed the people. Bangladesh is an agriculture-dependent country, whereas the available arable land is continuously decreasing since the 1990s and now it accounts for less than 60% of the total land area (see table below)[38]. The statistics show that in 2015, the average arable land per capita is 0.048 hectares[39]. The decrease of arable land has posed additional challenges for dairy farming. Grazing land is becoming more and more scare that constrains dairy farmers to acquire sufficient cattle feed.

[38] World Bank: https://data.worldbank.org/indicator/AG.LND.ARBL.ZS?locations=BD&view=chart
[39] World Bank: https://data.worldbank.org/indicator/AG.LND.ARBL.HA.PC?end=2016&locations=BD&start=1961&view=chart

Figure 13: Arable land (% of land area) in Bangladesh



Source: World Bank Data

As the majority of the cattle keepers are smallholder farmers, crop cultivation has been their main source of income. Priority has always been given to rice production because it is the main focus of government policy. For the intensive cattle rearing system, farmers take advantage of their own land or leased land to produce fodder. According to the samples collected from eight districts, most farmers use less than 40% of their land for fodder production, primarily for their own consumption. Only farmers who own more than 10 acres of land have the potential to turn fodder production into business, with 30%-40% of their production being sold to the local market. Under this situation, farmers need more productive and high yielding green fodder varieties to guarantee an adequate and steady supply of quality fodder.

Limited land has brought a challenge in terms of cattle herd expansion and facilities construction. Cows need spacious cowsheds and plenty of room for activities. Since households have very limited land, particularly in highly populated areas, when farmers begin to increase cattle number, land is then becoming the main constraint that prevents them from providing enough space for a growing herd.

In addition, the land is a key factor for farmers to be able to access financial support, especially for the bank loan. One of the crucial reasons for the financial exclusion of small-scale dairy or bull fattening farmers has been their inability to provide collateral to banks. For certain banks, the amount of loan is tied to the amount of land owned by farmers, or leased land in their own names. In addition, farmers are sometimes asked to have guarantors for taking loans, and the number of guarantors also depends on the size of land. Therefore, landless farmers have more difficulties in accessing finance if they want to expand their herds.

3.5.2 Veterinary services

One of the key cost components of cattle rearing is the veterinary services. Veterinary services are one of the main cost elements of cattle rearing. Since insurance service is not widely applied in the livestock sector, for small-scale farmers, any reduction in productivity or death caused by animal diseases will cause huge economic losses.

Therefore, on the one hand, farmers need to be familiar with the symptoms of common diseases and take preventive measures. On the other hand, it is necessary to make farmers access veterinary services whenever needed.

3.5.2.1 Cattle diseases in the country

Cattle, whether it is reared for milk or meat purpose, are susceptible to similar diseases. In Bangladesh, the most common cattle diseases are Foot-and-Mouth Diseases (FMD), Mastitis, Black Water, Diarrhea, Spasm, Gastric, Prolapse and so on[40]. Due to a lack of prevention measures and capacity in identifying diseases, livestock farmers in Bangladesh have suffered great losses. According to the Ministry of Fisheries and Livestock, annual loss due to only FMD has been estimated at BDT 1000 crore (US$ 125 million)[41].

Some irregular diseases can immediately decrease milk production, such as mastitis, diarrhea and black water (see table below). Among them, the mortality rate of Black Water can even reach 80-100%. Some diseases happen during or after giving birth to calves, such as prolapse, which may affect re-pregnancy and reproduction of dairy cows and decrease their value. Endemic seasonal disease like FMD can spread quickly among cattle herd and may lead to large-scale infection if not controlled in time.

Table 24: % decrease in milk production and mortality with various types of diseases

Disease type	% decrease in milk production	% of cattle die
Mastitis	70-100%	0-2%
Black Water	70-90%	80-100%
Diarrhea	50%	2%
FMD	30-60%	25-50%
Fever	10-30%	0%
Worm	20%	0%
Swollen Neck	0-5%	0%
Infertility	5%	0%
Gastric	50%	1%

Source: data collected from field survey

The root causes of diseases and poor animal health are mainly due to several reasons:

- Adoption of unhygienic and inappropriate practices. Cattle are easy to be infected if farmers adopt improper and unclean practices. For example, mastitis is the inflammation caused by unhygienic milking activities.
- Lack of nutrition and adequate feed. The cows are not scientifically fed with sufficient nutrients for their growth. This lack of nutrition results in a weak body, reduced immunity and poor digestive function.
- Inappropriate housing system. Unscientific cowshed design, limited spaces for movement, and a hot and humid environment will lead to animal health problems such as skin disease or swollen neck.
- Lack of usage or effectiveness of vaccination and de-worming tablets. FMD can be prevented if cows are vaccinated. However, due to improper storage and lack of awareness, vaccination hasn't been applied effectively. The existing vaccines cannot work for certain strains of FMD, particularly for those from India.

[40] Reported from interviewees.
[41] Guidelines on Animal Vaccines. Retrieved from: https://dgda.gov.bd/images/Draft_Animal_Vaccine_Guidelines.pdf

Adult cattle have a certain ability to heal under some circumstances, but certain diseases are more prevalent among calves. The mortality rate of calves is over 25% in the country. For FMD only, the rate reaches 51%[42]. Calves are kept in unsanitary conditions and receiving insufficient care, particularly on nutrition. Milk from lactating cows is being sold while no affordable milk replacer is available for calves. Malnutrition and undernutrition of calves will lead to irreversible harm to reach their full potential for milk or fattening, especially during the period when the mammary is forming.

Apart from domestic diseases, the control of transboundary animal diseases is crucial as well. Indian bulls come from a long distance by walking through hills and rivers, tired and unfed, reaching Bangladesh at high risk of having diseases. The bulls are then immediately sold in cattle markets. For cattle traders, it can be difficult to identify visually if the bull is sick in the market. However, diseases like FMD brought from neighboring country can quickly spread and infect other cattle. Currently, no effective vaccines are available to cure this disease.

3.5.2.2 Methods of prevention and treatment of animal health problems

Vaccination and controlling parasites

Small-scale producers are vulnerable to any losses that may be caused by animal disease. The disease threat may decrease if a series of prevention measures taken timely.

Vaccination is recognized as one of the most efficient ways of preventing diseases like FMD. Domestic vaccines are mainly produced and distributed by DLS. More universities and companies are involved in the research and development of animal vaccines. But still, the total vaccine production is not sufficient to meet the country's demand. Currently only 50% of the farmers vaccinate their cattle. The quality of vaccines is not ensured. One of the main reasons is that there is no complete cold chain and hygienic environment existing to protect them from contamination or cross-contamination. Bangladesh also imports vaccines but most of the imported vaccines work for foreign strains of FMD, which are not effective for local strains.

An increasing emphasis is given to the use of animal vaccines by the government. In 2018, the Directorate General of Drug Administration, the Ministry of Health and Family Welfare and the Government of Bangladesh together published "Guidelines on Animal Vaccine". This guidance aims to evaluate the benefits and risks of existing vaccines in Bangladesh and assist various stakeholders in identifying, purchasing and marketing the vaccines in the right purposes[43].

Compared to vaccination, the number of farmers who use deworming tablets is much less. When cattle grazing in open lands, parasites can easily enter the digestive tract and affect cattle's performance. Only 35% of cattle have been de-wormed in the country. The lack of or irregular usage of deworming drugs is mainly due to farmer's limited knowledge. They cannot identify parasitic infections through symptoms and indicators and are not aware of the importance of immediate deworming treatment.

Animal Health Laboratories

DLS has set up an Animal Health Central Disease Investigation Lab with nine field investigation labs attached. There are also 63 District Veterinary Hospitals equipped with mini-laboratories[44]. The existing nine labs and mini-

[42] Dr. Md. Mohsin Ali and Dr. Md. Ainul Haque. FMD Control Initiatives in Bangladesh. Retrieved from: http://www.fao.org/docs/eims/upload/299827/an356e00.pdf
[43] Guideline on Animal Vaccine (2018). Retrieved from: https://dgda.gov.bd/images/Draft_Animal_Vaccine_Guidelines.pdf
[44] Dr. Md. Mohsin Ali and Dr. Md. Ainul Haque. FMD Control Initiatives in Bangladesh. Retrieved from: http://www.fao.org/docs/eims/upload/299827/an356e00.pdf

laboratories geographically cover the country, with the aim of testing the samples, doing analysis and monitoring diseases. Usually, farmers bring their sick animals to the upazila office or animal hospital, to have diagnostics and tests. Unlikely, the labs are not in full operation as there is a shortage of human resources. Some of the veterinarians are trained to work in the labs. But they are sometimes sent to border checkpoints for quarantine purposes as well. Particularly in the central lab, the capacities are limited.

In addition, with a high animal and human density, some of the animal diseases can directly infect human health (e.g. Anthrax), while some diseases will affect the meat and milk quality leading to food safety issues (e.g. abuse of antibiotics). DLS does not have food safety laboratories associated with animal disease labs. The food safety inspection is mainly charged by the Ministry of Health. This requires an improvement of inter-ministerial collaboration.

3.5.2.3 Service delivery

DLS is committed to providing animal health services to rural farmers at district and upazila levels. Each upazila livestock office is equipped with veterinarians and field assistants. Farmers can bring their animals to the animal hospital for diagnostics and prescription, or call for field assistants to provide door-to-door services. The most common services that ULO provide is general diagnostics, pregnancy test, delivery of calves, AI services as well as surgeries[45]. The services are usually free of charge but farmers will pay for transport and medicines.

When there is an outbreak of diseases, the maximum visits per day for a veterinarian is 12 to 15. Compared to the cattle population and huge demand in high season, the number of DLS veterinarians are extremely scarce. Therefore, multiple actors engage actively in veterinary service provision to bridge the gap:

- Paravets who are linked to DLS often receive training through a youth development program of the government and obtain a payment based on the services that they provide. They are not officially employed by DLS, but can effectively assist ULO's veterinarians.
- In primary milk zones, companies such as PRAN, Milk Vita and BRAC provide embedded services including veterinary services to their suppliers.
- Independent veterinarians in villages, part of whom also work for pharmacies, offer diagnostics and act as sales agents of medicines.
- Animal health workers who have been trained by NGOs deliver services to members of producer groups. These workers usually receive regular training and are able to promote advanced technologies to farmers, such as using a test kit for mastitis and mixed herbs for recovery.

Table 25: Average price for different veterinary services

Type of service	Price
Door-to-door service (nearby)	200-350 TK
Door-to-door service (long distance)	400-500TK
General Treatment	200-300 TK
Artificial Insemination	200-450TK
Pregnancy Test	300-350 TK
Delivery of baby	800-1000TK
Vaccination	300-900TK
Surgery	700-1000TK

Source: Field survey

[45] Collected from field interviews.

3.5.2.4 Disease-free zone and monitoring

It would be quite difficult for Bangladesh to set up disease free zones as cross-border trade activities are still dynamic. The country is totally surrounded by India without too many natural barriers. To set up disease-free zones, it is important to create compartments to separate healthy and sick animals. However, the compartmentalization is much more costly and the brokers have little room to trade animals.

Instead of creating compartments in the country, special emphasis is then given to the areas with a high concentration of animals, where vaccination is widely used to maintain a disease-free status. Bengal Meat, the leading meat processing company in the country, tend to export their products to the international markets. To meet the standards, the company tends to set up a program in collaboration with the government in Pabna to provide high-quality meat by controlling animal diseases.

3.5.3 Extension services

The livestock extension services in Bangladesh aim to provide various services through different patterns to address the key bottlenecks in value chain segments and fill the knowledge gap. In Bangladesh, even though livestock rearing has a long history, the capacities of farmers are still inadequate to achieve good performance.

First of all, low capacities are mainly due to a lack of proper training on capacity building. Among various types of value chain actors interviewed, only 0.5% of farmers received systematic or intermittent training from DLS and NGOs. The majority of farmers learn from friends, neighbors or other farmers and accumulate experiences through years of practices. Training in veterinary requirements and husbandry practices, combined with a distribution of green fodder seeds, and access to formal sector collection markets, are the three elements which must be provided in unison to enable a household keeping only local cows to successfully transition to keeping cross-breed cows.

For milk collectors, the milk collection work is not very demanding on the profession thus none of them has ever received particular training. Meanwhile, very few collectors adopt hygienic practices when milking the cow or transporting the milk, resulting in potential animal disease and milk contamination. Milk collectors have very limited knowledge on testing the milk which enables them to verify if milk is adulterated from suppliers. This also happens to the traditional processors. They identify the fat content by a cream separator, but it's a long process and other types of adulteration can be difficult to identify. Even though traditional processors have accumulated years of experiences, most of them still lack knowledge on temperature control and the scientific way to make maximum Chana. Only one of the interviewed sweetmeat makers received a three-month training from ACDI/VOCA, the rest of them all learn from family members.

Regarding actors along the beef value chain, the shortage in capacity building is even more insufficient. A large number of butchers are not willing to use slaughter facilities, because of distance and limited number. Bangladesh Traders Association has provided training to their members regularly for the whole year including special sessions before Qurbani to enhance butchers' capacities, adopt new facilities like weight machine and raise their awareness on hygienic practices. However, apart from this, other similar training institutes are almost non-existent. Meanwhile, as the only beef processing company, Bengal Meat arranges training on modern livestock husbandry practices for their suppliers. The company trains farmers on how to produce and preserve fodder and how to take care of animals, particularly on disease prevention and shed preparation. Additional knowledge given to farmers is the steer production, which contributes to a higher quality of meat production.

For the hides taken off from cattle, 100% of the hide collectors interviewed use salt to preserve. But the quality can be deteriorated after slaughtering, if hides are kept for 9-10 hours without salting. As a result, the timing for collecting hides and the techniques for preserving are of equal importance to ensure the quality.

Furthermore, insufficient service delivery and coverage is also a big challenge. DLS is responsible for the delivery of all kinds of extension services at a different administrative level. However, DLS has very limited staffs and skill in service delivery, particularly at Upazila level, where most of the demands come from. NGOs, depending on their size and project scope, focus on particular zones for service delivery. Most of the services delivered by DLS and NGOs are free of charge. With an increasing engagement of the private sector, farmers have additional channels to approach services. Large companies usually provide embedded services to their suppliers. In this way, suppliers benefit from both sales and services which make them loyal to the company, while at the same time the company can guarantee the quality of milk received.

3.5.4 Labour market

The total population of Bangladesh has shown rapid growth since 1960 and now the country has become populous with a population of 165 million[46]. Despite the decline in poverty in Bangladesh in recent years, the improvement is still at a slow pace. Currently, one out of every four people in the country lives in poverty, while about 12.9% of the population live in extreme poverty[47]. With the rapid increase in population, youth population, aged between 15 and 29, has achieved almost 18 million, accounting for 29.5% of the employed population. However, around 2.68 million young labour still remains unemployed. Approximately 69.75% of the employed youth labour force are in rural areas. Agriculture, livestock, forestry and fisheries related work accounts for the largest share, at 41.2%, with the breakdown by sex, 63.0% were females. Also, most of the women work as contributing family workers, which are three times more than male workers48. Compared to the formal labour market, informal employment is, in fact, dominant with 91.8% females and 85.1% engaged and agriculture sector always takes the largest share. From the Labour Force Survey, it is clear that unemployment and underemployment is a big challenge in Bangladesh, and most of the young people have meagre wages and poor working conditions. Meanwhile, women have to face gender bias and cultural barriers which limits a lot their employment choices[49]. In addition, child labour is apparent in the livestock sector, particularly cattle rearing.

According to our survey, most of the small-scale farmers are self-employed in their own farm or own business, and the livestock-related work is usually jointly done by all the family members. But the division of work is quite different. In general, women spend a lot of time on conducting indoor activities such as housework and livestock rearing with very little fixed income, while men are often responsible for outdoor work like transporting milk or cattle, purchasing feed, contacting veterinarians, etc. Some of them also have jobs other than agriculture and livestock, as the main source of income for the family. Only large and medium-sized farmers (cattle herd >10) will hire one or more full-year labour forces to run the farm. However, instead of a formal contract, they prefer to make verbal agreements, with an average daily wage around 250-300tk.

[46] World Bank Data: https://data.worldbank.org/country/bangladesh
[47] Project Information Document: http://documents.worldbank.org/curated/en/247421499315596014/pdf/ITM00184-P161246-07-06-2017-1499322769269.pdf
[48] Report on Labour Force Survey (LFS) 2016-2017, Chapter 6 and Chapter 7.
[49] ILO: Youth employment policy brief: Bangladesh

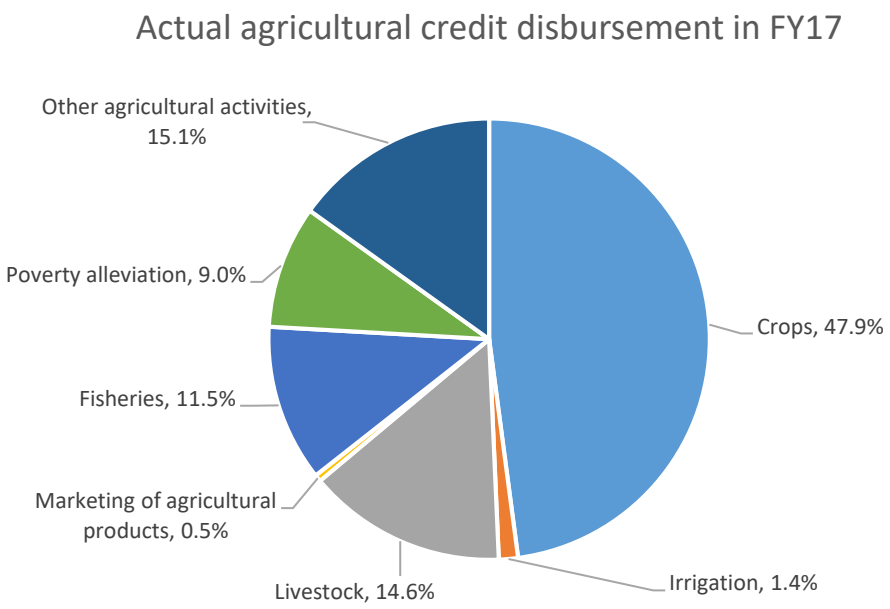
Sweetmeat making is also a key segment to provide job opportunities. Each shop hires around 4-12 workers, mostly youth, for sweetmeat making and sale. Due to the miserable working conditions, women are barely directly involved in this industry, but rather assisting their husbands if it's a family business.

Although Bangladesh still faces the challenge of solving youth unemployment and gender barrier, the rich population resources have brought enormous potential for economic development. Since agriculture and its related sectors, such as livestock, forestry, and fisheries, have absorbed a large amount of labour forces, the sustainable development of relevant value chains can create more decent jobs for youth and women, particularly in rural areas.

3.5.5 Access to finance

Value chain actors have access to finance through various channels, both informal and formal. According to the Bank of Bangladesh, BDT 30.57 billion had been disbursed to livestock sub-sector in FY 17, accounting for 14.6% (see table below). Bangladesh Bank's BDT 2 billion refinancing fund scheme has been brought out since 2015 by the central bank to raise milk production and artificial insemination. Dairy farmers can benefit a 5% interest rate from banks and non-bank financial institutions and the Government provides 5% cash subsidy[50]. The rate has further decreased to 4% in 2018. Apart from bank loans, MFIs, cooperative funds and private financing are the most common choices for value chain actors, particularly for small-scale producers.

Figure 14: Actual agricultural credit disbursement in fiscal year 2017



Source: Agricultural Credit Department, Bangladesh Bank

Producers

In Bangladesh, the majority of small-scale cattle keepers fund their businesses through their own sources. Usually, the milk sales are too minimal to become the primary source of income for the household. So the money used to invest in cattle rearing often come from their own funds or savings, such as crop sale, transport services and other types of labour-incentive work. More than 90% of the farmers interviewed expressed that there was no need for them to access external financial services. The rest of them approach funds from external sources, if needed,

[50] Annual Report 2016-2017, Bangladesh Bank, Chapter 9 Agriculture and MSME Finance

through informal and formal channels. The most common informal channel is borrowing from friends and relatives, which is the economic and fastest way. A few of them (<2%) went through formal channels. For example, cooperative members can benefit from their cooperatives' Cattle Development Fund which is saved from the collective milk sale. Some dairy farmers take loans from Micro Financial Institutes (MFIs). For example, TMSS provides loans in large amounts for dairy farmers with the aim of purchasing veterinary inputs and feeds. Field officer makes visits to lenders' farms to identify their business situations and analyze if they have the ability to pay back. Farmers who get loans from TMSS leave 5% as deposit, and with an interest rate of 2% per month.

Very few producers link to state banks or commercial banks, as the interest rate is relatively high (10%) that smallholders have no ability to repay the loans. A number of farmers approach bank loans through private companies. For instance, Sonali Bank Limited has signed an MoU with PRAN to provide loans with 5% interest rate for farmers working with PRAN. Lenders are recommended by PRAN and analyzed by Sonali Bank before issuing loans. In average farmers received 200,000TK. However, under this scheme, the conditions are stricter than MFIs. Farmers need to have own land or leased land with their names. The size of the loan is closely linked to the amount of land. They also need to provide benefit cards and National ID cards to show their identities. Also guarantors are requested as well. The rigorous conditions largely constrain farmers to access bank loans, if without receiving any help from companies or NGOs.

In general, the borrowed fund is used to purchase crossbreed dairy cows, heifers or essential inputs. With higher yield, dairy farmers are able to repay the loan with milk revenue. The new-born calves turn to be an additional income source. Currently, almost zero financial services are specifically targeting bull-fattening business, as it cannot bring immediate income to pay back the loans.

Traditional processors

None of the traditional processors interviewed has access to any external financial sources through formal channels, primarily because they manage to reinvest by own business profit. In some cases, if urgently needed, they choose to borrow money from friend and relatives. Traditional processors are not prioritized in the existing bank loan system.

SMEs

Dairy SMEs have more links with banks for financial support. They take loans from banks to purchase all equipment needed for milk collection and processing. Some SMEs are hesitating of taking loans in large amount as they are more vulnerable in the market compared to the leading dairy companies. Therefore, any threats may put the enterprises at the risk of not paying back on time. The Bangladesh Bank has also formulated a programme for SMEs called "SME Credit Policies and Programmes". BDT 1419.4 billion was actually disbursed in 2016, which was higher than the target of BDT 1135 billion[51].

3.6 Enabling Environment

3.6.1 Policies, Regulations and Laws

The focus of livestock policies in Bangladesh evolved over the decades, moving from government-centered animal disease control, to breed, feed, slaughtering and extension services development (see table below) which values increasingly the engagement of private sector. The important role of the livestock sub-sector in the national economy has been emphasized in the country's five-year plan for the purpose of realizing self-sufficient in

[51] Annual Report 2016-2017, Bangladesh Bank,

domestic supply and poverty reduction. In 2007, the Government of People's Republic of Bangladesh issued the "National Livestock Development Policy" (NLDP) which has specified the development objectives of the livestock sector and set the scope and implementation strategy. The general objective of the NLDP is:

"To provide the enabling environment, opening up opportunities, and reducing risks and vulnerability for harnessing the full potential of the livestock sub-sector to accelerate economic growth for reduction of rural poverty in which the private sector will remain the main actor, which the public sector will play facilitating and supportive role."[52]

The NLDP encouraged the participation of the private sector in livestock development, while shifting the role of the public sector to a facilitator and enabler. Meanwhile, the government clearly identified the main constraints and development priorities in dairy, meat, poultry and by-products sub-sectors. The barriers, including a lack of appropriate breeds, quality feed, veterinary services, credit support and insurance coverage, as well as a knowledge gap of smallholders and absence of market information and regulatory body, have turned to be the main targets of the subsequent policies. Similar obstacles are also faced by meat production, while special attention has been paid to the enforcement of legislation regarding the unsatisfactory sanitary conditions of slaughtering and meat inspection.

In addition, there are some targeted policies covering specific aspects as listed in the table below. Despite the fact that a series of policies and acts have come into effect, ineffective execution remains a great challenge. According to the field survey, more than 2/3 of farmers interviewed recognized that the policies and regulations provide a favorable environment for cattle rearing, however, they cannot clearly tell the exact benefits acquired. Dairy farmers care more about the price of feed and milk. They would like policies to guarantee quality feed at a good price and the government to influence the price of milk. Similarly, bull-fattening farmers would prefer more control on the cross-border cattle trade as such huge amount of smuggled Indian cattle will significantly influence the local cattle price.

Table 26: Livestock policy and acts

1920	Bengal Cruelty to Animals Act
1957	Animals Slaughter and Meat Control Act
1962	Prevention of Cruelty to Animals Ordinance
1982	Bangladesh Veterinary Practitioners Ordinance
2005	Bangladesh Animal and Animal Product Quarantine Act
2005	Animal Disease Act
2007	National Livestock Development Policy
2008	Avian Influenza Compensation Strategy and Guidelines
2008	Animal Disease Rule
2008	National Poultry Development Policy
2009	Bangladesh Zoo Act
2010	Animal Feed Act
2011	Slaughter Act
2013	National Extension Policy

Source: Department of Livestock Services (DLS), Policy & Acts

For milk collectors in general, they are not aware of any policies or regulations that are favorable for their business, but those in the secondary milk zones (e.g. Dinajpur) are demanding for more industrial collection centers to

[52] National Livestock Development Policy (2007)

absorb the overproduction of milk. Traditional processors generally feel that there is no supportive policies and regulations particularly for sweetmeat industry and their products cannot be certificated by BSTI because of short shelf-life. The slaughtering activities are usually monitored by the Municipality or Upazila Livestock Officer, but not consistently in all districts. Meanwhile, there is no particular standard for butchers to maintain when selling fresh meat. Consumers concern more about unadulterated food, however, there is no means for them to trace the origin of products or obtain adequate information about their quality.

3.6.2 Product and process standards and norms and their compliance

Food safety is always one of the core criteria when consumers purchase certain products. In Bangladesh, the enforcement of regulations, rules and acts is weak due to insufficient resources and unclear institutional arrangement. There are various ministries involved in animal-sourced food products but their roles and responsibilities are disbursed. Industrial dairies get caught periodically by producing unsafe products and get temporarily shut down. But this temporary punishment does not solve the problem fundamentally, as certain companies re-open without having made major re-adjustments. Gradually consumers will lose trust in the industrial processing products thus undercutting the market demand. The food inspection for traditional products is less frequent and enforcement is weak. Most traditional products cannot meet food safety standards and the working conditions are poor. Low-quality products may generate less income for traditional processors. As a result, the flow of value is limited through the chain.

Similar problems are observed in cattle slaughtering. Even though DLS has issued two slaughter acts, the enforcement guidelines are not clearly defined, resulting in disorganized slaughtering practices existing in the country. Meat sold in the wet markets or from roadsides does not have any quarantine certificate. Consumers may risk having food-borne diseases by eating the low-quality or contaminated meat products.

3.6.3 Physical Infrastructures

3.6.3.1 Transportation: road condition and cool chain

For the dairy sub-sector, transportation is an essential influential factor. It determines whether milk and dairy products can be delivered to consumers promptly under conditions of freshness and good quality. In Bangladesh, most milk producers and collectors use traditional methods of transport. They use the spelter or stainless steel milk pots to collect raw milk and send it to the milk collection center or intermediate products processors on foot or by tricycle truck. For producers from char areas, boats are needed to ship the milk to the local market. These can be only used for a short distance because of the limited carrying capacity. Large milk processing companies have set up milk collection centers in many parts of the country, most of which are equipped with testing and chilling facilities. Since most of the milk collected by the companies is sent to big cities like Dhaka or peri-urban areas, usually the companies have their own milk trucks which are equipped with refrigerated facilities to ensure that the milk is kept in a suitable temperature during transportation. Companies usually have their own transportation network so in this sense the collection and distribute channel won't be a great challenge. However, road conditions in Bangladesh are not perfect. Due to the river channels across the country, roads in many regions are not well connected. Moreover, some well-established roads have a great possibility of being destroyed by floods during the rainy season and cannot be repaired in time. Coupled with the traffic congestion in large cities such as Dhaka, the transportation time is further lengthened, which greatly affects the quality of milk. Road conditions also affect greatly the efficiency of service delivery. For farmers living in remote areas, they have to pay higher veterinary fees as the transport cost is relatively higher.

Due to the long transportation time, a complete cool chain is essential to guarantee the quality of milk and dairy products. In most of the cases, the collectors (gosh) are the only link between producers and processors. Although collectors will sell out all of the milk to the processors within a half day, however, in summer, the milk will be easily get spoiled with such high temperature, thus creating food losses during the collection phase. For the processing stage, the traditional sweetmeat makers lack the basic testing machines to inspect the raw milk quality,

only judging based on their years of experiences. Once the sweets are done and sold in the shops, the leftover is usually being kept in the normal temperature rather than in the refrigerator, or being directly thrown away which conducts to a lot of food wastes. Dairy companies have better performance compared to the traditional processors in terms of storing products as they have set up modern cooling facilities to ensure quality control.

3.6.3.2 Electricity and water supply

The electricity supply in Bangladesh is not stable nor reliable. In 2010, the BBS mentioned that 90% could have access to electricity in urban areas while only 42% in rural areas. The supply is far behind the demand. Power cuts are quite often which affect a lot the dairy farming. With the promotion of Holstein-Frisian breed, the crossbreed has a lower level of heat tolerance, therefore, the installation of fans in the shed will be necessary to keep cows in a comfortable environment, which can further reduce related animal diseases and be good for animal welfare. However, this is not well applied in most part of the country, as the installation cost is high and the electricity supply is quite unstable. The shortage of electricity also creates big constraints for the local collection points. As the cooling facilities need to be functional all the time, any power cuts will hinder the operation of the machines. Therefore, all the collection points have to prepare the back-up in order to maintain the facilities functioning. This leads to additional cost for the milk collection.

Meanwhile, dairy companies also face a big challenge in terms of electricity supply. As for industrial use, the government charges a higher fee per unit, which increases the operational cost of the processing plant. Meanwhile, to make sure that the plants have a constant electricity supply, companies have to use diesel generators which generates harmful air pollution. Some of the companies have taken initiatives in setting up solar panels to mitigate the negative environmental impact.

3.6.3.3 Telecommunications

Using mobile apps is a useful way to help farmers adopt better dairy farming practices. Government and NGOs play an important role in promoting the apps and teaching farmers how to use it. For example, the application Feed Master developed by BLRI guides the producers to learn proper ration formulation for their cows depending on the weight and breed. Farmers can also set vaccination reminders to make their cows vaccinated in time so that to avoid a big loss due to serious animal diseases.

Leading dairy and meat companies have also adopted new business models to promote their products online through their own e-platform. Urban consumers then have more channels to access dairy and meat products. Company like Bangal Meat starts a trial on promoting online cattle trade for Qurbani, which leads to a new trend for cattle transaction.

3.6.4 Technological, institutional and organizational innovation

A great number of public and private institutions are actively engaging in research and service promotion for the development of dairy and beef sub-sectors. Among all the actors, the DLS works within the mandate of the Ministry of Fisheries and Livestock (MoFL) and plays a lead role in dairy development. It carries out a series of extension services including artificial insemination, genetic preservation, veterinary services, and vaccination promotion at national wide.

Bangladesh Livestock Research Institute (BLRI) is a national institute whose aim is to solve the problems associated with the livestock sector by conducting modern researches. Established in 1984, BLRI is mainly committed to improving productivity, increasing incomes and improving livelihood standard of farmers. The institute has taken the leading role in developing new technologies with the aim of increasing production of meat, eggs and milk, and promotes them nationwide. A total of 56 technologies and 19 packages have been innovated and mainly delivered

at the local level through DLS. One of the initiatives that is being promoted by BLRI is using Moringa as cow fodder to increase milk production. Study shows that milk production can increase by 40% to 60% by feeding Moringa. BLRI develops a variety of animal vaccines for the control of animal diseases (like FMD).

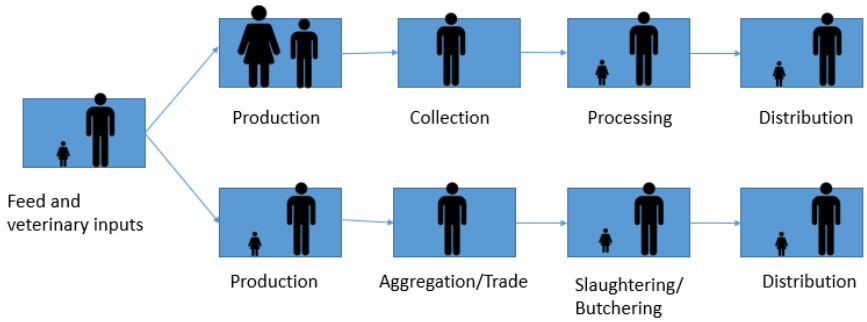
Development organizations and NGOs are actively engaging in providing innovative models or technologies for improving dairy and beef value chains. As a new model, the school milk feeding programme has been applied jointly by FAO and Milk Vita to expand local demand and improve nutrition for children. Local NGOs are assisting farmers in adopting new technologies to improve their farming practices, such as using test kits for mastitis, or calculating feed ratio on the mobile phone. In general, advanced technologies are not widely applied in the practices. Some pioneers (NGOs and researchers) test in pilot areas but more technical support and exchange with the external world is needed.

3.6.5 Socio-cultural norms

For small-scale farmers who raise cattle, nearly all family members are involved in daily farming activities, while the role for men and women are not the same. Most of the women are mainly engaged in daily care such as preparing home-made and on-farm feed, milking and cleaning the sheds. While men are taking care of the activities outside the homestead, such as delivering and selling milk and cows, seeking services and purchasing feed for cattle rearing. There are fewer women involved in farms that are fully engaged in bull-fattening because the bulls have greater weight and strength which are difficult to control. In terms of land ownership, 85 % (verify) of the land is owned by men and very little land is jointly owned. This largely constrains women to join cooperatives and access finance. According to the survey, most of the interviewed households responded that the income from selling milk or cattle was basically shared by both husband and wife. But when deciding on the direction of re-investment (e.g. purchasing a new cow), man's opinion is decisive. Women tend to spend more on food to improve family nutrition.

For aggregation segment, it is completely male-dominated and women are rarely seen involving in relevant activities. The key reason is that milk collection or cattle trade is a work of strength that men are more likely to be competent. The similar situation works for traditional processing and slaughtering. Only for the family business of sweetmeat making, women play an assistant role in helping their husbands working in the backyard. Currently, more jobs have been provided for women through formal channel. With advanced facilities, the demand for physical strength is reduced which allows more women to be involved in the processing activities. Certain women in senior-level have engaged in business plan making and marketing strategy design. But still, for jobs like veterinarian or transporters, women are significantly underrepresented.

Figure 15: Gender distribution in dairy and beef value chain



Source: made by authors

More projects are being brought out to empower women in dairy sub-sector. In some milk zones, the establishment and widespread practices of milk collection centers or chilling centers near villages make it possible for women to go outside the house and sell the milk by eliminating the need to leave their villages. However, for more remote areas, the barriers are still there as they depend mainly on informal collectors who go door to door to collect milk.

Moreover, more and more women producer groups are emerging. Those are smallholder farmers, who are the major targeting people of different projects of development agencies or NGO. With the help of funded projects, members of the producer groups can directly receive training, inputs and other services such as veterinary services and AI service. Of course, there are some new job opportunities created for women as well. Some work as nutritionists and receive professional training in order to advice group members on nutrition intake and health care. Some women have also become small entrepreneurs who sell inputs and medicines to group members or the village people in order to have extra income. Women in the producer groups have better control of their milk income and more powerful in decision making.

3.7 Natural environment

3.7.1 Climate change

Due to its low-lying landscape and high population density, Bangladesh is a country which is highly vulnerable to natural disasters such as cyclones, flood, landslides and drought. With frequent extreme weather caused by global warming, Bangladesh's agricultural sector has suffered massive finical losses. Regarding the livestock industry, the impacts of climate change are mainly reflected in the following aspects:

1) Impact on animal health. As the temperate breeds are widely promoted throughout the country, the crossbreeds of temperate and local cows show low tolerance to high temperature and humidity. From March to June, the temperature can reach as high as 40 degrees. Under these conditions, there is an increased risk in animal diseases and mortality of calves. In addition, the high temperature makes the spread of the disease faster and more difficult to control.

2) Impact on animal feed. For green fodder, extreme weather like cyclones or flood may lead to a decrease in production. And the rising sea level turns farmland near coastal areas into saline land, making it even more difficult to grow fodder and crops.

3) Impact on financial losses. All the situations mentioned above will cause huge financial losses for livestock farmers. However, most of them have no access to insurance to mitigate the risk when facing natural disasters. In addition, a lack of information services leads to delays in forecasting extreme weather conditions beforehand.

3.7.2 Cow dung management

Cow dung is an important by-product which can be used for multiple purposes. In average, one cow will generate 4-5kg of cow manure per day. From 121 farmers interviewed across ten districts, only 0.08% sell cow dung to get an extra income. Mostly, cow dung is kept for own household usages.

The majority of farmers use cow dung as fertilizer on their rice fields. Sometimes cow dung is collected and strung with a stick, then the dried or caked cow dung can be used or sold as fuel. Farmers who have extra income by selling cow dung aggregate more in the milk zones. They often sell to intermediate processors, such as chhana makers, who need in large amount for their production.

Besides serving as fertilizer and fuel, cow manure has multiple usages. With the help of NGO or experienced village leaders, a few farmers and cooperatives begin using cow manure to produce biogas, which can generate electricity and heat. This is beneficial to rural villagers that often suffer an unstable national electricity supply. Biogas installation is a way out of this gap and makes people access to affordable energy.

In areas where the overproduction of cow dung is common, farmers tend to serve it as fish feed. However, most of the manure disposed into fish ponds or lakes is untreated. Sometimes due to the high concentration of certain minerals, fish are killed in large amount meanwhile affecting the water environment.

3.7.3 Environmental compliance of tanning industry

Bangladesh tanning industry now facing a great challenge in its environmental compliance. The tanning industry is one of the pillar industries with considerable growth in Bangladesh which supplies annually 180 million square feet of skins and hides53. However, the industry brings severe environmental issues. The old tannery cluster in Hazaribagh areas locates near Buruganga River, which is the mother river across Dhaka city. After processing the raw hides, all effluent has been directly poured into the river or the fields nearby without any treatment, which makes the river and soil so contaminated. Also, instead of disposing collectively of the solid wastes, factories simply dump near the roadside. The hazardous wastes existing in the river and the surrounding areas pose a huge risk for the ecosystem and human health.

To solve this issue and meet the requirements of the international buyers on environmental compliance, the government selected a new site at Savar to build a new tannery village with Central Effluent Treatment Plant (CETP), chrome recovery unit, central dumping zone for solid waste and other infrastructures. Tanneries are obliged to move their factories to the new place, and all the liquid and solid wastes will be treated collectively. Currently, around 220 tanneries in the old cluster shifted to 155 tannery plots at Savar. The CETP has four modules in total with sufficient capacity for all tanneries in the village if it's in full operation.

[53] Bangladeshi Leather Industry: an overview of recent sustainable developments.

3.8 Systems dimensions

3.8.1 Value chain governance

3.8.1.1 Dairy value chain

Different sub-value chains within the dairy value chain operate independently, but with some inter-dependencies and influence each other. The degree of the influence (and their varying forms of governance) that the sub-value chains have on each other can be described by geographical location – with influence and dependence higher in the primary milk zones, lower in the secondary and emerging milk zones, and lowest in the non-milk zones.

Industrial channel

The value chains in which the industrial dairies are present are quasi-hierarchical. In zones with the presence of industrial dairy collection systems (e.g. Milk Vita, Pran, BRAC, etc.), the majority of farmers are dependent on these companies as the primary large and viable market. The leading dairy companies generally dominate and govern the value chain, whereas a few SMEs are also involved but with limited influence and scale. The intermediate and traditional processors also operate, but represent a far smaller market.

The industrials set prices for upstream and downstream actors in the value chain. This domination by the few industrial firms affects other actors in milk supply chains that do not even supply to the industrial dairies, such as traditional processors, and the informal collectors who set prices in reference to the prices of the industrial dairies. In the primary milk zone, where there is much competition for milk, the informal collectors often need to pay a higher price than the industrial dairies to collect milk, thus making little profit. While in emerging milk zones, with less competition for milk, the informal collectors who supply the traditional processors continue to pay lower prices, as the collection schemes of the industrial collectors do not absorb all the milk in the area and without the traditional processors farmers would be in over-production.

The industrial dairies are vertically integrated, increasing their power in the chain against their smaller buyers and suppliers. Except for primary production, industrial dairies encompass the rest of chain segments from collection, processing, distribution, marketing to retailing. As major processors for value-added products, dairy companies capture the most value with higher quality and food safety standards.

The industrial dairies define the milk quality, setting a scale for price linked to fat content, which they change during the year to create incentives for farmers to supply more milk, or to discourage farmers from supplying more milk than the company can process in the flush periods. The industrials have far more knowledge and operational capability, and share this with downstream actors to enable farmers and collectors to supply milk meeting the companies' requirements.

With regards to its downstream, the industrial dairies in general have own distribution networks and retail shops.

Traditional chain

Dairy farmers are the most numerous and weakest of the value chain participants in the traditional milk supply chain. In the traditional milk supply chain, the milk collectors are key actors who link farmers to the market. Hence, collectors have the most influence on pricing and product quality. In the secondary and emerging milk zones, the collectors set the prices at which they collect raw milk from farmers. The price can be very low (30TK/L or lower) in areas where the industrial dairies are not established, or where milk is in high supply. The quality of raw milk is low, sometimes adulterated, without any governing standards.

When the raw milk flows to the traditional processors, there is a wide range of prices in sweetmeats. The prices generally depend on regions, varieties, even sellers (with longer history or better reputation). The processors can

adjust the prices of the final products and gain the highest margins and income. To ensure milk supply, many of the sweetmeat makers have collectors as their employees, or independent collectors who work primarily with them. In this case, the market power shifts to the sweetmeat markers who have more influence on the price setting. In milk zones, the traditional processors face significant challenges because the farmers and collectors gradually shift to the industrial dairies to get a fair payment based on the milk test. To maintain a long-term relationship, the processors sometimes have to offer a higher price than the industrial dairies which increase the cost of production.

However, the sweetmeat makers sometimes are tricked by the collectors by receiving adulterated or diluted milk. They are unable to protect themselves from such cheating, resulting in a decline of value captured. Due to a lack of laboratory tests and quality standards, the negative impacts are visible. Farmers are not incentivized to produce better quality milk and processors are depressed by the low-quality product.

Often the sweetmeat makers are also retailers. In this sense, the midstream and downstream is vertically integrated as the processors own the connection with the end-market. The targeting consumers are residents, hotels and restaurants.

Clustering and geographical differentiation

In the primary milk production zones (e.g. Sirajganj and Pabna), the milk market is dynamic and competitive with collectors and processors competing for the milk produced. Although the industrial dairies have the most power with their presence in these areas, their influence is not spread throughout the country as they represent only 5% of the dairy market. However, the penetration of industrial actors influence the local cattle rearing practices, drive farmers' incentives and enhance their capacities. As a result, the change also affects the performance of intermediate and traditional processors in terms of setting price and quality standards.

In the secondary production zones (e.g. Dinajpur and Rangpur), the milk market is nearly saturated driven by the installation of industrial processors. However, the oversupply is becoming a severe issue recently as the industrial processors are reducing their procurement volumes in consideration of their business strategies. Farmers suffer from the lower quantities of collection and lower prices, which are likely due to milk being collected primarily by suppliers rather than directly by industrial processors. As a result, traditional processors and the collectors are less dependent on the industrial processors, leading to more flexibility in price setting (become lower) and less stringent quality control. Seeing the limited profits from milk sale, many farmers in the areas are gradually shifting to bull-fattening which has a longer process but better profits.

In the emerging milk zones (e.g. Khulna, Jessore, Satkhira, etc.), the milk market is somewhat dynamic but with fewer market options. The collection points of industrial dairies are disaggregated and distant so the capacities are relatively low. Local entrepreneurs are emerging which absorb part of the milk supply. Therefore, producers still depend mostly on collectors and have fewer choices. With multiple models operate simultaneously, there is more variety in prices.

Apart from these three situations, the dairy value chain in peri-urban (e.g. Gazipur, Savar Union) shows unique characteristics. The advantage for peri-urban producers is that they are close to the end markets and the demand for fresh milk is high due to a large population in the cities. The milk price can reach 50-70 TK/kg, twice as much as that of the milk zones. For peri-urban producers, milk production is a highly profitable business and the price is mainly dependent on the market, not farmers themselves. Large-scale producers can be found (e.g. near Chittagong and Feni) in these areas only targeting urban markets. The dairy value chain under this situation is much shorter and simpler because there is only one transaction from the producers directly to the consumers.

Horizontal linkage – organization and business associations

Milk producers, in general, are unorganized and fragmented. The organized group started with Milk Vita cooperatives. In recent years, there is a growing number of producer groups supported by NGO or funded projects but on a limited scale. There are no independently functioning producer groups in dairy sub-sector.

In terms of collectors and traditional processors, there are no association or business groups which integrate these actors. They function as individual or family businesses. With limited bargaining power, they are also the most neglected value chain actors who have barely received any training or technical and policy support. Without associations or groups that enhance their power, these small and fragmented actors lose any ability for segment organization or representation in bargaining or advocacy with the government, lead firms or the actors in other value chain segments.

For industrial dairies, they form a business association through which they attempt to influence the government on policies that would benefit their businesses, such as raising the tariff on imported milk powder. Compared to individual traditional processors, industrial dairies are more influential in conducting policy dialogue and making their voice heard by the government.

3.8.1.2 Beef value chain

Vertical linkage

As bull fattening is mostly dependent on the dairy industry, meaning that small-scale farmers make up the majority. They either sell bull calves which they cannot keep, or old cow no longer producing milk. In this case, farmers make a small income from the cattle sale and are generally trying to recover value before it is lost. Some large-scale bull-fattening farmers usually have better capabilities. With strong capital invested, they can better assess services and market information.

Cattle traders have the most power in the cattle supply and trading for beef consumption, particularly for Eid. To be more specific, large traders take advantage and balance support and demand gaps by moving cattle all around the country, while small traders operate in a particular area where they have the flexibility and look for opportunities. Cattle traders are generally price setters and capture the most value in the supply chain of live animals. They only own the cattle for a short time and can adjust the quantities according to the market demand. They can choose the best purchasing timing when the selling market is good (e.g. Eid). If the time to buy is not ripe, they are not forced to do so. Traders evaluate the animals based on their breed, size, age as well as other characteristics and prices are set accordingly. The margin for each cattle is not very high but traders make huge profits through large quantity and high frequency of transactions.

Butchers usually purchase cattle from the nearby market or fixed suppliers (farmers or traders). Live animal purchase accounts for more than 75% of their total revenue[54].

Horizontal linkage

There is almost no organization or producer group for bull-fattening farmers. Only one works with Bengal Meat with support of a local NGO. The whole segment is very fragmented and vulnerable as farmers have low bargaining

[54] 3ADI+ survey

power and are price takers. Similar to traders, they generally work for their own without any formal organization. Some informal groups are existing but quite marginalized.

The situation has been changed for butchers as a national association has been founded within Dhaka city– the Meat Traders' Association. Each major city has a meat traders' association which groups butchers and works with City Corporation for cattle slaughtering. The Meat Traders' Association has achieved some breakthroughs for its members, such as promoting digital weight machine and providing training to raise their awareness. In spite of that, the association still has very capacities in well-delivering know-how to butchers. The most urgent issue is to improve the slaughter facilities, but the whole process is advancing slowing because of limited resources and scale.

3.8.1.3 By-products value chain governance

Hide and Tannery

The linkage between butchers, hide collectors and tanneries is quasi-hierarchy. Tanneries play a dominant role which set the prices and control the demand for hides. The vast majority of the tannery output is exported, but most of the tanned hides are not certified due to environmental problems.

Large hide collectors are also powerful but have market dependence on the tannery sector, where the sales are concentrated. When tanneries are being shifted to the new location, the demand is massively restricted, resulting in a sharp decrease in hide price and quantity collected.

Butchers are the least powerful actors in this supply chain as prices are usually set by tanneries and collectors. For butchers, the sale of hides is an important income element but they are the most vulnerable actors affected by the price. Also, the lack of slaughtering skill resulting in lower quality of hides also decreases their revenue.

Bone supply chain

The bone supply chain is dominated by one lead firm, Global Capsule. The company set prices for chipped bones based on its need and inventory of bones. The chippers and different levels of collector fulfil a basic function and follow the pricing structure defined by Global Capsule. For butchers, the bones that cannot be sold with meat have no particular value. But in recent years, urban butchers have a growing awareness to sell the unused bones to the collectors. Although the profit is not much, it is still a benefit for them.

Feed supply chain

The supply of feed ingredients and ready-made feed, either locally produced or imported, is dominated by feed companies. The feed companies set the prices in the downstream segments using the Maximum Retail Price (MRP). The profitability of the animal feed prices depends on the market price of ingredients. The distributors/sellers are very powerful. For example, for poultry sub-sector, the distributors are middlemen who dominate the supply of both feed and DOC. But they are still entirely under the domination and contractual responsibilities to the feed companies. Farmers are general price takers, the current high price of animal feed contributes to a high rearing cost which undermines their profitability.

3.8.3 Overall competitiveness

The end-market analysis shows that there are no great end-market gaps in dairy and meat. According to government, or by WHO recommendations, there is a quantitative market gap in milk, but according to the real

demand of the population, based on cultural habits, preferences and behavior, there is no evident gap. Demand could grow slowly with increasing purchasing power, but the market gap is not huge as expected. Also, there are no apparent unseized opportunities as the entrepreneurial and business culture in Bangladesh is strong that any appeared opportunity will be taken (even like bones and hides). For the market that not yet mature, companies are trying to take as well. For example, Bengal Meat is targeting a niche market even though only very limited population (more middle class) can really afford it.

As regards the traditional dairy products, a huge number of producers and products existing in the value chain. Apart from the common types, there are some well-known products in particular areas, or even in particular shops. Also, some more innovative sweetmeats are emerging to enrich the varieties. While for the industrial processing products, the mainstream products are generally pasteurized milk, UHT milk and curd. Some product innovations have attracted new market share but yet become mainstream (such as flavored milk). The European style cheeses are also produced, but in a limited scale, as they do not meet cultural tastes and local purchasing power.

In terms of meat, the informal meat sector shows a strong presence as the population prefers. There is a large number of roadside butchers, wet markets, micro-markets across the country where the majority of people purchase meat. But consumers are more or less satisfied with the meat quality and not asking for better products. The formal meat sector is very small and not favored by the majority. Only middle or upper-class people with a better income would prefer to consume. However, the increasing understanding of food safety in the population, matcher with increasing incomes, could create a demand gap for safe and quality meat.

The national market is very competitive with a large number of actors involved in the industry. However, dairy is undermined by a low global price of powder milk which affects a lot the domestic production, as processors prefer to use cheaper powdered milk instead of raw milk. The beef market is relatively isolated but affected a lot by smuggling activities. In the global market, the whole dairy and meat sub-sectors still have low competitively in terms of quality and quantity, particularly compared to neighboring countries like India.

3.9 Sustainability performance

3.9.1 Economic sustainability dimensions

In dairy sub-sector, farmers are mainly price-takers resulting in a relatively low profit. But the situation varies. Dairy farmers in urban and peri-urban profit more as the price is much higher due to its close distance and huge demand in metropolitan cities. Farmers generally have limited bargaining power so that they can only passively take whatever price is set by their buyers. Collectors have better profit margin (<20%) than farmers in less developed areas as they are price-setters; while in major milk zones, it's less profitable as the prices are mostly controlled by industrial dairies or large sweetmeat makers. Traditional processors generally have a profit margin of 28%. By producing diversified value-added products, the processors are the actors who benefit the most from the whole dairy supply chain.

As regards meat sub-sector, there is a significant seasonality influence. The profit margin for each value chain actor reaches the highest during the Qurbani period. As there are few farmers are completely involved in bull-fattening, they capture less value by providing low-quality bulls. The business of peri-urban and urban for butchers are more profitable than other districts. The majority of butchers have a small profit margin, around 1%-8%.

For both value chains, the actors with considerable incomes capture the most value, such as industrial processors, traditional processors, cattle traders and the processors in the hides and bones value chains. They either produce a variety of value-added products, or play a dominant role in controlling the transaction. Meanwhile, from the

consumption perspective, consumers require more affordable products with high quality. Under the current situation, as margins are minimal in both dairy and meat value chains, so the objective is mainly to improve the quality of products rather than making products less expensive. However, a drastic increase in prices will also not be possible in any case as the vast majority of consumers do not have high purchasing power which prevents them from purchasing more expensive products on a regular basis.

Furthermore, in terms of the government revenue, in the existing value chains, only traditional processors, SMEs, industrial processors as well as downstream value chain actors pay taxes, at least VAT. Cattle traders and butchers often pay market taxes, while farmers and small-scale and entrepreneurial milk collectors do not pay any taxes. Therefore, an improved and more profitable value chain would result in an increase in government revenue.

Despite the fact that the value is captured differently throughout the value chains, none of the upgrading principles would lead to any one group winning increased value capture at the expense of another value chain actor. The increase in value capture would be based on reductions in cost, particularly for farmers and traditional processors, particularly the fragmentation of the production sector should be changed with an improvement of the services provided. In this way, dairy farmers are more powerful in choosing the buyers providing a reasonable price and at the same time reduce the production costs. Meanwhile, the collectors who have gained money by adulterating or diluting milk will not be able to profit as it used to be if traditional collectors are able to perform laboratory tests and protect themselves from such adulteration, resulting in improvement in quality. Even though the support to the traditional value chain could be thought to threaten the industrial dairy value chain, it will not as the power balance and actor concentration is so unequal, and the targeted product markets are relatively different.

3.9.2 Social sustainability dimensions

Nutrition

Bangladesh is among the countries with the highest rates of malnutrition in the world. The prevalence of malnutrition affects mostly children and women. According to FAO, “more than 54% of preschool-age children, equivalent to more than 9.5 million children, are stunted, 56% are underweight and more than 17% are wasted”[55]. Bangladeshi children and women, particularly for pregnant and lactating women, are suffering micronutrient deficiencies. Improve access to dairy and bovine products with affordable price is one of the most efficient ways to ensure the nutrition intake and diversify the diet. The dairy and bovine products can provide a verity of essential nutrients include Vitamin A, calcium, phosphorus, protein, potassium, sodium, etc.[56] in an easily absorbed form to keep body function properly. And for children particularly, milk-based products can be essential for their growth and cognitive development. In this sense, enhancing the development of Bangladesh dairy and beef sub-sectors will contribute substantially to improving the nutrition status of the population. However, compared to beef, the consumption of milk and dairy products is far beyond the adequate amount. This is not only due to a national wide low milk production, but also because of low awareness and inadequate education of the importance.

Food safety

Food safety issues exist all along the dairy and beef value chain. Even though more and more consumers are aware of the importance to access safe food, they are still not able to identify what safe food is. Due to a lack of transparent traceability system, consumers have difficulties in obtaining enough information in order to judge if

[55] Nutrition country profiles, FAO. http://www.fao.org/ag/agn/nutrition/bgd_en.stm
[56] Milk and Dairy Products in Human Nutrition, FAO,

the production and processing of certain products have met the standards. In Bangladesh, due to huge demand, the supply of dairy and bovine products can directly affect public health.

Food contamination from raw meat is an important cause of food-borne disease outbreaks or food poisoning due to improper handling. During production, processing, and storage, these products are subjected to contamination by pathogenic bacteria. For meat products to comply with international standards of quality and safety, one must constantly monitor the hygiene and quality standards in the handling and processing environments of meat products. Most meat is handled under unsatisfactory sanitary conditions in both rural and urban areas. Modern restraint devices are not available in local slaughterhouses. There is no application of humane slaughtering methods in Bangladesh, and animals who are transported to slaughterhouses are not subject to any legal restrictions, so slaughter depends on the expectations of the local slaughter men and slaughterhouse owners/managers. Slaughter in open markets or even in disorganized slaughterhouses results in extremely unhygienic practices for disposing of blood, viscera and other wastes.

The slaughtering and dressing of food animals take place in a disorganized way and unsanitary conditions in the country. There are many self-made field abattoirs in rural and urban areas, small towns and even in cities where slaughtering of cattle, sheep and goat by unauthorized butchers in roadsides, fields, bushes, backyards or at house premises. Absence of effluent treatment plant in slaughterhouses owned by the city government is another major concern for environment safeguard. Usually, the animal traders purchase the animal from the local areas and sell them to the urban markets. Butchers purchase the animal from the animal market and slaughter in the primitive slaughterhouses. Butchers act as meat trader both in local and urban areas without concerning meat safety. The finished products are transported to meat shops by rickshaw or open van and exposed to health hazardous agents.

Youth

Currently, the unemployment rate of the country is 4.2% while for youth particularly, this rate increased to 11.37% in 2017, meaning around 2.68 million youths are unemployed[57]. A great number of youth labors have shifted from agriculture-related work in rural areas to industrial or business-oriented work in peri-urban or urban areas. With the development of livestock sub-sector, more job opportunities will be generated and more young entrepreneurs are supported to start livestock –related business. Youth training can be provided to unemployed youth for self-employment, also as a way out of poverty.

3.9.3 Natural environment sustainability dimensions

The negative environmental impacts may happen all along the value chain in different forms. During the production phase, cattle rearing may cause environmental hazards and affect human health. For example, zoonotic diseases can be easily spread between animals and humans. A weak control in animal diseases may lead to an outbreak of infectious human diseases. Meanwhile, the disposal of urine, cow dung and animal carcasses have become an environmental issue. Animal waste is not fully or properly used, such as urine or cow dung which may also lead to environmental issues, particularly in areas with high population density. Other impacts happen during daily practices, such as waste of water, gas emission, flies, parasites and dust (MN Alam, 2016)[58]. For collection and processing, energy use is the main concern. Traditional processors commonly use wood as fuel in the open space which may cause deforestation and create air pollution. With the scale-up of milk and meat production, environmental concerns must be taken into consideration when designing the upgrading models.

[57] Bangladesh Statistics 2017

[58] Impact of livestock rearing practices on public health and environmental issues in selected municipality areas of Bangladesh. Bangladesh Journal of Animal Science.

4. Opportunities for investment

4.1 Vision

Within the next five years, by 2024, more small-scale farmers and other value chain actors will produce dairy and beef products of a higher quality and value, leading to improved profitability for actors in each segment, a safer supply of affordable food to the population, and greater value chain sustainability. Specifically:

- The ***industrial channel of the dairy value chain*** will expand to include an additional 15,000 small-scale farmers. They will operate with improved farm management capabilities, and will be incentivized to provide quality milk to collection centers. The farmers will supply a system of 75 village milk collection centers, and five milk collection hubs, all of which will be launched within the context of 3ADI+. The hubs, operated as Public-Private Partnerships, will also coordinate a feed-for-milk scheme which will reduce the production costs of rearing cattle, without significantly altering the marketing mechanisms or cash flow of farmers. These improvements in the industrial dairy value chain will achieve sustainability by engaging private sector partners in business operations, while being inclusive of small-scale farmers and eliminating the potential negative environmental impacts.
- The actors of the ***traditional channel of the dairy value chain*** will produce higher quality and safer products for Bangladeshi consumers. Over 4,000 traditional processors will be trained annually to use improved processes, and provided access to processing tools and technologies, equating to upgrading nearly 4% of the traditional processors in Bangladesh each year. Ten training institutions, established by 3ADI+ partner organizations, will provide the training. In order to implement the upgraded processing methods, traditional processors will incentivize their suppliers to provide higher quality, unadulterated milk, leading to product upgrades in all upstream segments of the traditional dairy value chain. In order to comply with the demand for quality milk from the traditional processors, another 15,000 farmers in the traditional channel will be supported to use improved farm management techniques. (Thus, in total, 30,000 farmers will improve their production practices and the quality/value of their milk, equating to nearly 1% of the cattle rearing households in Bangladesh with cross-breed cattle, and which approach milk production as a business.) The training institutes will work in perpetuity to continue upgrading the processes and technology of traditional processors, who will continue to incentivize other value chain actors to provide higher quality and higher value milk.
- The actors of the ***beef value chain*** will produce a higher quality and safer fresh meat for consumption. Sixty upgraded slaughter facilities will enable slaughters/butchers to provide meat to consumers, which complies with basic food safety standards, making 10% of the country's beef safe for consumption, not counting the animals slaughtered for Eid al-Adha. The upgrading of slaughter infrastructure will provide a model which can be replicated in other slaughter facilities, also impacting other livestock value chains.
- Additionally, at ***the systemic level of the value chains***, food safety monitoring will be strengthened to reinforce the upgraded processes used by the traditional dairy and beef sub-value chain actors, with a certification of food safety and traceability signifying the improvements in process and product quality. Further, consumers of these products in urban areas will know the characteristics of safe dairy and beef products, and will be enabled to use market power to demand safer products from processors and butchers, also creating incentives for sustainable value chain upgrading. Finally, national level trade associations, in the segments which currently have no such organizations, will enable actors in the different value chain segments to operate cohesively, and to influence policy and legislation, to support the coordinated upgrading of the value chains.

4.2 Core upgrading strategy

Summary of 3ADI+ strategy in Bangladesh

In Bangladesh, the 3ADI+ strategy focuses on three primary objectives, each with a set of strategic interventions. Each strategic path includes direct support to existing and new actors in various value chain segments, as well as interventions targeted to influence the systems within with the value chains function. The support to the value chain actors, and the systemic interventions, work together in an integrated approach to achieve the three objectives. The first objective relates to the industrial dairy value chain, the second to the traditional dairy value chain, and the third to the beef value chain.

Objective 1: To expand access to modern, technologically improved management practices, processes and business models, to more producers, milk collectors and processors, while closing regional market gaps, and without production quantities surpassing the expected growth in demand for packaged dairy products. A key element of the objective involves integrating more small-scale milk producers into the industrial value chains, which incentivize the use of good practices and higher milk output and quality, while also developing regional market systems, and reducing the production costs of cattle farmers. One result will be the creation of quality off-farm jobs for women and youth in rural and peri-urban areas, in the collection and processing sectors. Although industrial, measures have been identified in each segment of the value chain, to eliminate any possible negative environmental impacts.

Objective 2: To increase the quality and safety of traditional dairy products by supporting traditional processors to prevent milk adulteration, reduce value loss and waste, and increase value while supplying affordable products to consumers with limited purchasing power. A key element of the objective is the incentives which the traditional processors will establish for milk producers and collectors, to enable their own use of improved processing methods and technology, which will also be accompanied by direct 3ADI+ support to producers. Beyond the work with producers and traditional processors, systemic levers of change include a food safety and traceability certification which will verify and reinforce the good practices used by value chain actors, an educational marketing campaign to educate the population and build demand for safe dairy products, and the creation of trade associations to enable actors to influence government policy.

Objective 3: To increase the quality and safety of animal (beef) products by supporting farmers to maintain animals and products free of illnesses and contamination, and by constructing slaughter infrastructure which enables slaughters and butchers to provide meat to consumers that complies with food safety and hygienic standards. The systemic interventions related to the certification, marketing campaign and the trade associations, also relate to Objective 3.

Priorities and goals underlying these objectives include to organize the value chain so as to make it more responsive to support services, to innovate and standardize the practices and processes used by value chain actors, to increase the inclusive and equitable value capture throughout the chain, and to prevent any negative environmental impacts resulting from increasing the increases in quantity of production, and to empower consumers to demand quality products as a method of reinforcing the upgrades throughout the chain.

4.2.1 Expanding access to the industrial dairy value chain

Integrated intervention with focused upgrading in the primary production, aggregation and industrial processing segments of the value chain, with supporting changes instigated in the systemic dimensions of the enabling environment, focused on establishing producer associations, sector/segment wide trade associations, a food safety certification as a business support service, and an educational marketing campaign to build knowledge about food safety and demand on the part of consumers

Focused on boosting milk output and creating market systems for more farmers, using the quality approach and better practices of the industrial value chain actors. The strategy developed based on interlinking of the producers, collectors, a larger collection hub to secure milk in volumes large enough to interest industrial buyers, and a capacity at this hub to produce pasteurized milk in bulk or retail packaging.

The number of actors in each segment forecast to receive support is estimated based on the amount of milk which the formal sector market could possibly absorb considering realistic growth rates (of 5%) over the proposed five years of the project.

PPP milk collection hubs

- The establishment of PPP milk collection hubs, with milk pasteurizing and packaging capability, will collect bulk volumes of milk in the emerging and secondary milk zones, thus managing quantities of milk viable for inter-regional trade, as well as serve as the controlling mechanism for the feed-for-milk scheme. Such hubs will generate rural and peri-urban value creation, as well as creating quality jobs in rural areas, while eliminating all potentially negative environmental impacts. Depending on the regional milk supply and target markets, the PPP hubs may be replaced by the launch or expansion of SME industrial processors.

Begin description of this strategic track, with the PPP hubs, as they represent the proposed wholesale aggregation (and processing) points where milk will be collected, in order to be sold to different buyers.

The table below summarizes the quantities of milk expected to be collected by the PPP hubs by the conclusion of the 3ADI+ program in Bangladesh, and compares these quantities to the overall milk production, and the milk collected by the industrial dairy companies.

Plan to establish five hubs with a daily collection capacity of 30 MT, equating to 10,950 MT of milk annually per hub, and 54,750 MT annually by all five hubs. This quantity of milk equates to only 1.3% of the national milk production of 2017, or 4.2 million MT. Using a growth rate of 19.5% (the average growth rate of the last decade) to forecast the milk production in five years, predicts that an additional 7.96 million MT/year of milk will be produced by that time. Therefore, in five years, the capacity of the hubs would equate to less than one percent of the national milk production.

Compared to the milk collected by the industrial processors in 2017, the collection capacity of the five hubs equates to over 26% of the total, of 207,873 MT. The processors are expected to collect an additional 56,836 MT/year in five years, to reach the processing volumes expected in five years. The projected capacity of the five hubs is over 96% of this expected annual increase in milk collection by 2024. Two implementation strategies, based on different methods of partnership with the industrial diaries, are described in the hub business model section of the Investment Opportunity chapter, one of which involves close integration of the activity with an industrial processor company, and the other treats the industrial processors as buyers of milk from the hub. In either case, the industrial dairies would be a significant part of the market for the hubs. However, the hubs can also sell pasteurized milk to retail points in their regions, as well as selling milk to larger traditional processors. Therefore, with these second options as alternative markets for the hub's collection of milk, this market projection remains viable. Projecting to establish more than five hubs over the next five years, would unlikely result in the infrastructure being used to its full capacity.

As an alternative approach, also mentioned in the Opportunities for investment section, is to support the launch or expansion of SME industrial processors, which would operate in a similar way, but require lower investments and collect less milk. Such an approach would be suitable for areas with less milk production potential, as determined during the course of implementation.

Additionally, with an expected 40 employees per hub, the establishment of five hubs would create 200 quality jobs.

Table 27: PPP milk collection hub comparative analysis

	Units	Quantities
Milk/hub/day	MT/day	30
Milk/hub/year	MT/year	10,950
Total number of hubs	Hubs	5
Total milk collected	MT/year	54,750
National bovine milk production (2017)	MT/year	4,157,452
Collection capacity of 5 hubs compared to the national bovine milk production (2017)	**%**	**1.32%**
Expected national bovine milk production in 5 years (by 2024)	MT/year	12,119,484
Expected additional milk produced (by 2024) based on growth rate (of 19.5%/year)	MT/year	7,962,032
Collection capacity of 5 hubs compared to the additional milk produced nationally in 5 years (by 2024)	***%***	***0.69%***
Milk collected by industrial milk processors (2017)	MT/yeawr	207,873
Collection capacity of 5 hubs compared to the milk collected by industrial processors (2017)	**%**	**26.34%**
Expected milk collected by industrial processors in 5 yrs (by 2024)	MT/year	264,709
Expected additional milk collected by industrial processors (by 2024) based on growth rate (of 5%/year)	MT/year	56,836
Collection capacity of 5 hubs compared to the additional milk collected by industrial processors in 5 years (by 2024)	***%***	***96.33%***

Village milk collection centers

- An expansion of the formal sector milk collection systems will extend formal sector milk markets further into emerging milk zones, through supporting milk collection entrepreneurs and cooperatives to establish VMCCs.

The village milk collection centers (VMCCs), launched by individual entrepreneurs or farmer cooperatives, on a cost-sharing basis and with 3ADI+ support, will extend the milk collection systems anchored by the hubs into proximity to the farmers.

The number of VMCCs is estimated based on the number of PPP hubs, and is therefore within the same market size guidelines. With a forecast milk collection capacity of 2 MT/day, 15 VMCCs will supply each PPP hub (with a capacity of 30 MT/day). Seventy-five VMCCs would be launched to supply the five hubs.

With three employees per VMCC, the 75 new VMCCs would result in the creation of 225 quality jobs.

Primary production (livestock farmers)

- Capacity building of livestock farmers, delivered through a lead farmer model to associations, will focus on imparting methods of increasing profitability per cow by focusing on milk quality and quantity through correct nutrition, health care, community-oriented disease and health monitoring, and improved farm management practices.

Assuming that the supported farmers will keep HF cross-breed cows with average yields of 10 liters/day, or 3 MT/year, 292 cows will be required to supply each VMCC at capacity. With the typical small-scale farming family assumed to keep 1.5 cows on average, 195 farming households will be linked with each VMCC. Therefore, the operations of the five hubs will create markets for fresh milk for 14,600 farmers. Assuming also 40 farmers (representing 40 households) per cooperative, 265 livestock farmer cooperatives will be established or revitalized within the context of the 3ADI+ program's work in expanding the hub-based, industrial processing collection system.

With about 17,220,000 households keeping livestock in the country (verify in statistical data), this number of farmers is less than one percent, in fact it represents 0.08% of livestock farmers.[59] Considering only those farmers who keep cross-breed animals, the program's target group represents 0.21% of these farmers.

Feed-for-milk scheme:

- A scheme to provide the farmers with concentrate feeds at a reduced cost, through a market system operated by VMCCs and PPP milk collection hubs, will reduce the production costs of milk and improve profitability, even within the industrial dairy price regime.

The coordinated upgrading activities involving the producers, milk collectors and hubs, which assures fresh milk markets in proximity to farmers, and links them to the industrial milk value chain, will also be used to establish a scheme by which the farmers are paid for their milk in concentrate feed, in addition to cash. This scheme, described in more detail in the Investment Opportunities section, will decrease the cost of concentrates for farmers, which is the most expensive element of their production costs, and lead to improved farmer profitability.

Summary of economic benefits and return on investment

The table below summarizes the financial results for the farmers, VMCC entrepreneurs, and PPP hub operators. The figures for net income/actor, for both the current situation and the expected scenario resulting from program activities, are shown in the financial statements for the different actors, discussed in the following chapter on Investment Opportunities. The table below provides income results per actor, and for the total number of actors to participate in the program, using the number of actors forecast for support as discussed in the proceeding discussion.

For farmers, the interventions are expected to yield a 35,063 BDT gain per cow per lactation period. This is a represents an 188% increase in profitability per cow. The return on investment (ROI) calculation divides the additional income expected to be earned by all farmers supported in this component of the project by the capital investment cost of establishing the five PPP hubs (including the cost of equipment, technology, civil works and land). The cost of hub construction is used as the investment cost in the case of the farmers, because only minimal investments in capital assets are foreseen for the farmers, while the ultimate objective of establishing the PPP hubs is market creation and production cost reduction for farmers. The ROI is 44% in the first year, growing to 221% in year five, assuming no new major investments beyond year one.

[59] The number of farmers keeping livestock is estimated based on Bangladesh's population of 164 million people, with about 60% living in rural areas, and 70% of these keeping livestock, divided by an average family size of four.

For VMCCs, no initial net/income per actor is shown as the VMCCs will be launched within the context of the 3ADI+ program. The annual income when operating near capacity is forecast at 1/3 million BDT, or over 15,000 USD. The first year ROI considers the 3ADI+ investments in equipment and technology, but not the smaller investments in land and structures, as these latter would be the responsibility of the entrepreneurs. Thus, the ROI from the perspective of program capital investment costs, and VMCC earnings, is 44% in year one, and 220% by year five (only coincidentally similar to the producer ROI).

Finally, as the PPP hubs also do not exist currently, only the expected net income is shown. This net income is the gain captured by the private sector company who will operate the hub, after a 50% profit share with the local government and/or the supplying farmers (as discussed further in the Investment Opportunities section). Earnings to the company are expected to reach 13.3 million BDT, or over 58,000 USD. Earnings could be greatly increased if the company sells more of the milk pasteurized and packaged, however the forecast shown considers the hub to function more as a milk aggregator than a milk processor – while it will have both capabilities. Since the local governments will own the hubs, rather than the private sector companies themselves, no ROI can be calculated. As described below, in the most likely implementation scenario, the companies will lease the infrastructure from the local governments for a share of profits.

Table 28: Summary of income changes to value chain actors, before and after the program interventions

Incomes generated and ROIs	Units	Farmers (per cow)	VMCCs	PPP Hubs
Before intervention				
Income/actor	BDT	18,618	-	-
Income/actor	USD	222	-	-
Income/all actors supported	BDT	271,815,500	-	-
Income/all actors supported	USD	3,235,899	-	-
After intervention				
Income/actor	BDT	53,680	1,320,149	13,341,000
Income/actor	USD	639	15,716	158,821
Income/all actors supported	BDT	783,729,000	99,011,160	66,705,000
Income/all actors supported	USD	9,330,107	1,178,704	794,107
Difference				
Income/actor	BDT	35,063	1,320,149	13,341,000
Income/actor	USD	417	15,716	158,821
Income/all actors supported	BDT	511,913,500	99,011,160	66,705,000
Income/all actors supported	USD	6,094,208	1,178,704	794,107
Financial ratios				
% change	**%**	**188.33%**	**-**	**-**
ROI to actors, 1 year	**%**	**44.21%**	**44.07%**	**-**
ROI to actors, 5 years	**%**	**221.07%**	**220.35%**	**-**

4.2.2 Increasing quality in the traditional dairy value chain

- Improving the capacity and technology used by of the traditional dairy processors of sweetmeats, curd and ghee, will influence suppliers to increase the quality of milk supplied and reduce adulteration, while also providing a safer and higher quality product to consumers.

3ADI+ will partner with universities, NGOs or other institutions serving the target territories of the project, to launch training institutes, which will be attended by the traditional processors to build their techniques and capacities, as well as to purchase laboratory and production equipment, enabling them to make higher quality, safer sweetmeats and traditional dairy products. 3ADI+ envisions to support the launch of five training institutes, although the number of institutes is based on the operational realities of identifying capable partners and launching the institutes, rather than any limitation in the market. In fact, launching more training institutes would result in a greater of traditional processors being trained at a faster rate – thus accelerating the impact of the project in other regions.

Each institute is expected to train about 412 traditional processors/year, so that when operating at this capacity, the ten institutes will train over 4,000 students on an annual basis. Likewise, since the institutes will be launched in the second year of the program, over the four remaining years, nearly 16,500 processors will be trained in the context of 3ADI+, with more processors continuing to receive training and technology indefinitely into the future. With 109,520 processors in the country, 3.76% of them could be trained by the ten institutes in one year, with over 15.05% trained during the duration of the program. As shown in the table below, it would take 27 years to train all of the traditional processors in the country, without counting re-training. Therefore, the five institutes will serve as models for replication, with different private or public sector institutions establishing such institutes in the different districts of the country.

Table 29: Parameters of the proposed launch of traditional processor institutes

Number of institutes launched by 3ADI+	Institutes	10
Students/institute/year	Students/year	412
Total students/year in all institutes	Students/year	4,120
Students/4 years (of 3ADI+ program)	Students/project	16,480
Total number of processors in the country	Processors	109,520
% of processors trained in 1 year	%	3.76%
% of processors in 4 years	%	15.05%
Years to train all processors in the country	Years	27

Primary production (livestock farmers)

Generally, the farmers who supply milk to the traditional processors do not invest in cattle nutrition or health, or have knowledge of best practices in farm management. This low level of value chain development results from the farmers having no incentive to improve their milk quality, because neither the milk collectors, nor the traditional processors request the higher quality. Following the training and technology provision for the traditional processors, they will have the knowledge and tools to require higher quality milk and they will influence collectors and producers to supply this milk. Working on their own, processors may teach the collectors that supply them on a regular basis to test milk to prevent adulteration. Collectors will also press farmers for better quality milk with a higher fat content.

Therefore, the package of interventions delivered to the farmers in the strategic track focused on the industrial dairy value chain, will be delivered to farmers supplying the traditional dairy value chain. With over 2,000 traditional processors to be trained per year, and 75 VMCC to be launched in the course of the program, the traditional processors are far more numerous. While the VMCC are forecast to collect 2 MT of milk per day, the amount collected by typical sized traditional processors varies, from less than 150 liters to 300 liters per day in

the mid-range. Calculating roughly, using 150 liters of milk daily as an average quantity purchased by a processor, if each is supplied milk from 30 farmers (with cows producing 5 liters/day of milk, then the processors trained in the first year would collect milk from 61,800 farmers, and the processors trained in the four years of the program, from 247,200 farmers. This number of farmers far surpasses the number of farmers trained in the activities focused on the industrial dairy value chain.

Not only is the number of farmers greater, but the farmers supplying traditional processors in many zones of the country have the potential to be more profitable than those supplying the industrial dairies, as traditional processors pay a higher price than the industrial diaries. Therefore, 3ADI+ will also support farmers in the clusters with a high concentration of traditional processors who have attended the training institutes and are upgrading their processing methods. 3ADI+ will support about the same number of farmers supplying traditional value chains, as it plans to support which supply industrial value chains, bring the total number of farmers supported through the formation of associations and capacity building to 30,000.

Summary of economic benefits and return on investment

The strategy of establishing training institutes enables very broad based impact and high returns on the investment of project funds. The financial efficiency is further enhanced by the low cost of upgrading the traditional processing businesses. As discussed in the Core Value Chain chapter, traditional processing requires low capital inputs, and the new equipment and technology to be introduced to the processors, to support their better practices, is also inexpensive. The institutes will purchase this equipment in bulk amounts to gain economies of scale in procurement and re-sell these tools and implements to the processors at small margins. The improved practices which the processors will learn will lead both to cost savings in certain products and higher quality in all products, yielding premium prices. As shown in the table below, a typical processor will see income gains of 2.5 million BDT, or nearly 30,000 USD. Comparing these gains to their capital investment in equipment and technology, processors will achieve an ROI of a nearly unheard of multiple of 24 in one year. Comparing the gains of all 2,060 processors forecast to be trained by the five institutes in each year, to the capital investment required to launch the institutes, yields an ROI at a multiple of 132. This is the impact of working through a training institute as a lever of development. Focusing on actors who are already established, and whose processes can be upgraded at minimal cost, yields results – in terms of the quality of their output and their profitability, as well as on the quality in upstream value chain segments – which far outweigh the investment.

Table 30: Income changes to traditional processors, before and after the program intervention

Description	Units	Traditional processors
Before intervention		
Income/processor	BDT	4,801,973
Income/processor	USD	57,166
Income/all processors with upgraded processes	BDT	9,892,063,786
Income/all processors with upgraded processes	USD	117,762,664
After intervention		
Income/processor	BDT	7,314,978
Income/processor	USD	87,083
Income/all processors with upgraded processes	BDT	15,068,853,650
Income/all processors with upgraded processes	USD	179,391,115
Difference		
Income/processor	BDT	2,513,005

Income/processor	USD	29,917
Income/all processors with upgraded processes	BDT	5,176,789,864
Income/all processors with upgraded processes	USD	61,628,451
% change	**%**	**52.33%**
ROI to actors, 1 year	**%**	**24.4**

4.2.3 Increasing quality in the beef value chain

- Improving the infrastructure and machines of the slaughter facilities, and the capacity of the slaughters and butchers, will also increase the quality and safety of meat available to the population.

Three models for the upgrading of infrastructure and equipment of slaughter facilities are proposed, with one suitable for the large slaughter facilities in Dhaka and the other major cities, one to assure basic hygienic standards in the wet markets, where there is currently no slaughter infrastructure, but where very many cattle are slaughtered, and one or the roadside locations, which are also currently not intended to be used as slaughter facilities, but where the majority of animals in the country are killed. The 3ADI+ program intends to upgrade or create 20 facilities of each of the three types, with the actual distribution and number of facility types to be determined based on local needs analyzed during the implementation phase. About 53 cattle are expected to be slaughtered per day on average in the large facilities, 14 in the market facilities, and 14 in the roadside facilities. With each butcher/slaughter killing an average of one animal per day, and with 313 days of usage per year (with no slaughtering on Mondays), 509,929 cattle are expected to be slaughtered hygienically in the updated facilities, with 1,629 butchers selling hygienic meat.

With 9,634,400 cattle slaughtered in 2017-18, and about half of them, or 4,817,200 cattle slaughtered for the sacrifice festival of Eid al-Adha, the cattle slaughtered in the upgraded facilities would represent 5.29% of the total slaughtered, or 10.59% of the half of cattle slaughtered during the year, not including those killed for the festival. Since half of the cattle slaughtered in the country are killed on the day of the sacrifice, nearly all of these are not killed in slaughter facilities. Therefore, it is reasonable to estimate that over 10% of the beef available in the country would meet food safety and hygienic standards, as a result of upgrading the 30 slaughter sites.

While the ultimate goal of the intervention is to increase the quality of the meat available to consumers, as well as to ensure that this meat complies with food safety standards (is not contaminated, does not carry food-borne illnesses, etc.), it is essential that the butchers and organizations involved in the slaughter process fare better economically after the intervention than before – to ensure that they are incentivized to continue using the improved practices. The table below shows that the slaughter facilities would lead to additional income from the sale of meat and cattle byproducts of 648,375 BDT annually per butcher, equating to over 7,700 USD, or a 37.6% income boost from selling higher quality and safer animal products. Across the 1,629 butchers expected to be impacted, the increase in profits amounts to over one billion BDT in added value annually, equivalent to over 12.5 million USD/year. These results amount to an ROI of a multiple of 3.3 on the capital investment costs of upgrading the infrastructure and machines of the 30 slaughter facilities.

Table 31: Income changes to butchers, before and after the program intervention

Description	Units	Butchers
Before intervention		
Income/actor	BDT	1,724,230
Income/actor	USD	20,527
Income/all actors involved	BDT	2,809,058,042
Income/all actors involved	USD	33,441,167
After intervention		
Income/actor	BDT	2,372,605
Income/actor	USD	28,245
Income/all actors involved	BDT	3,865,368,979
Income/all actors involved	USD	46,016,297
Difference		
Income/actor	BDT	648,375
Income/actor	USD	7,719
Income/all actors involved	BDT	1,056,310,938
Income/all actors involved	USD	12,575,130
% change	**%**	**37.60%**
ROI to actors, 1 year	**%**	**3.3**

4.2.4 System interventions

Other interventions will influence the underlying systems within which the traditional value chain functions. These system-focused interventions will initiate changes which will support and reinforce the work of 3ADI+ with actors in the traditional diary value chain and the beef value chain.

- The creation of sectoral trade associations, in the value chain segments where they do not currently exist, will enable the fragmented actors to operate as a collective and to learn how to influence the national policy discussion. Such associations will be created at the level of primary production, milk collection, and traditional dairy processing, and revitalized for meat traders. Through this method, segment actors will be able to gain economies of scale and influence issues such as legislation on tariffs, as mentioned.
- The food safety system existing in Bangladesh will be supported through the creation of certification signifying that the processors and other actors with the certification follow improved food safety practices, which guarantee a basic level of hygiene and security at Bangladeshi standards, and that product traceability has been established to some extent. While establishing full traceability in an environment of limited information and oversight would be too costly, building some points of traceability an increasing actor capacity to establish traceability, will have a great impact on the safety of food for the population, and serve as a model for replication and expansion. The certification of food safety and traceability will signify to consumers the advances achieved by program participants in the value chain segments. The certification will also reinforce the improved practices of actors by attributing a market value to them, as the certification will guarantee safety and quality and fetch a premium price.
- Targeted segments of consumers of dairy and beef products will be educated on what constitutes safety and quality in these products, as well as motivated through educational advertising to demand higher quality and safer products from processors and suppliers. The campaign will initiate a shift to consumers using the power of the market to influence the value chains to upgrade in quality and value. The campaign

will also reinforce the process upgrades of the value chain actors, by informing consumers of the value inherent in the safer and higher value products, and creating additional demand for these products.

By integrating the proposed business model interventions and the systemic interventions during implementation, they will complement each other, and positively influence the value chains.

4.2.5 Stakeholder platform

A stakeholder platform will coordinate and implement the program. The 3ADI+ platform will involve a group of different international and Bangladeshi institutions, each of which having particular expertise in the livestock sector, the segments of the dairy and beef value chains selected for inclusion in program strategy, and the enabling environment, as well as extensive operating experience in the regions of the country targeted for sector development within the program. The institutions will be represented by individuals who make up the operational group which leads and guides the platform, otherwise known as the steering committee. These institutions will include the national government, represented by DLS; the university system, including BAU and other regional universities located in the geographical territories selected for project implementation; local governments and city corporations located in the territories for project implementation, organizations working in food safety, including the BFSA; UN organizations, including FAO and UNIDO; private sector companies working in the livestock related sectors; representatives of producer and other segment-based associations, after they have been established by the program; and, international, national and local NGOs with activities in the dairy and meat sector, and operating in the territories of program implementation. These institutions will participate financially and otherwise in the implementation of the program, with different institutions assuming leadership for the implementation of different components (later described as the specific Outputs) of the program.

In the sections which follow, describing the models used to upgrade the core value chain actors, as well as the systemic interventions, the operational methods which the 3ADI+ stakeholder platform will use to coordinate implementation is clarified, as related to each specific business model or intervention. The institutions leading the implementation of each business model or strategic intervention are referred to as the stakeholder platform members or platform partners.

4.3 Core value chain business models

The sections which follow describe the support which 3ADI+ will provide to existing and new value chain actors in different segments of the chains. The interventions and approach to implementation are described, and business models are presented, which demonstrate how the proposed the core value chain upgrades are economically feasible and technically viable.

4.3.1 Primary producers (business model 1)

Description of the intervention

The 3ADI+ stakeholder platform will organize and facilitate trainings on key topics, which will have the most impact on increasing the quality and quantity of milk produced per cow. The objective ultimate objectives of the work in the primary producer value chain segment is to make milk production more profitable and less risky for small-scale farmers. To achieve these objectives, capacity building trainings will aim to increase the output of milk per cow and increase the fat content in the milk through proper feeding. Results will include increasing profit margins and reduced risk for small-scale farmers.

With higher profitability per cow, and less risk in the business, farmers will be able to up-breed their herds using the available artificial insemination services – gradually expanding their productive asset base (cows), as well as the value (output/day) of those assets. As noted in the core value chain section, many small-scale farmers cannot grow their herd, because their livestock rearing/milk farming business operates at a loss. As a result, they are

forced to sell their female calves rather than expanding their herd. Greater profitability and less risk would enable them to retain their female calves, without subsidizing their livestock activities with earnings from other income generating activities.

By focusing on small-scale farmers, the intervention targets the largest segment of livestock farmers, as well as those which face the most difficulties in engaging sustainably in market systems. Larger dairy farmers with better farm management practices and more productive cows, already operate profitably as milk producers.

Therefore, the ultimate objective is to upgrade the capacity of the small-scale farmers, as well as the technologies that they use. As a result of the training, the farmers will seek improved services for insemination and animal health, as well as improving their own feeding and herd monitoring practices. As a result, farmers will standardize and innovate their farm management practices, which will also lead to the production of a higher quality product, and milk with a higher content of fat and protein.

Focus on increasing productivity per cow, not the number of cows: Support to farmers will not focus on increasing herd sizes or the number of cows per household. Instead, the focus is on increasing the productivity and the quality of the milk produced per cow. (Over time, farmers may themselves increase herd sizes, building on their improved knowledge and skill, however this objective will not be promoted in the context of 3ADI+.) Among the many reasons not to focus on increasing herd sizes, three prominent concerns follow.

1. Cows emit methane which is a GHG which has a negative impact on climate change. The livestock sector globally is a significant contributor to GHGs. While up-breeding cows leads to larger cows which also emit GHGs, the impact is less than when increasing the number of cows. Similarly, more cows would produce more dung. While in most districts, the dung is used by household for fuel or fertilizer, in some areas dung is in over production and poses an environmental hazard. Increasing drastically the number of cattle would accentuate the environmental hazard.
2. Due to Bangladesh's high human (eighth in the world) and cattle population density, many farmers lack space to expand cow sheds and pens, and lack the land necessary to grow additional green fodder. Therefore, the focus is on increasing the productivity within the same allocated space, rather than increasing the number of cows, and the amount of space required for the activity.
3. Livestock rearing, when not implemented using the best veterinary and farm management practices, entails a significant amount of risk, and can easily result in a financial loss. Such losses happen more often and are more devastating for small-scale farmers, who have fewer resources and less technical capability. As discussed in the financial analysis of livestock as a primary production activity, when farmers have more cattle but fewer lactating cows, the farm can easily face cash flow difficulties, making feeding the animals from the proceeds from milk impossible. Increasing the number of cows per farmer could result in more losses to farming households.

Bull fattening: While the objective is to upgrade the cattle rearing and milk production practices of small-scale milk farmers, the same trainings would also be delivered to farmers focused on bull fattening. The farmers engaged in bull fattening may be the same or different than the milk farmers. Only small adjustments would be necessary to adjust the same training curriculum to be relevant for bull fatteners, such as including different feed ration mixes.

Partnership and modality of implementation

The scalability of the intervention is based on its replicability, and that the training curriculum and supporting approaches, once tested in the field, will be replicated by different development partners. The trainings will be delivered at the level of the association through a lead farmer model, with lead farmers participating in the

trainings, and then communicating the learnings to their association members. Depending on the members of the 3ADI+ stakeholder platform and partners, the trainings could be delivered through a variety of mechanisms. Given the high population of Bangladesh and the sheer number of small-scale milk farmers, different mechanisms could function simultaneously in different target territories. The delivery mechanism used would depend primarily on the available partner per territory, and could include the following.

1. 3ADI+ and its partners develop the training curriculum; DLS is supported to expand staff in the targeted areas, who work with the lead farmers to deliver the field based training.
2. 3ADI+ and its partners develop the training curriculum, and support local or regionally focused NGOs to work with the lead farmers, to deliver the field based training.
3. 3ADI+ and its partners develop the training curriculum and an industrial diary company works with the lead farmers to deliver the field based training; in this case, the specific topics of the 3ADI+ curriculum would be added to or integrated with the embedded services already provided by these companies. In this case, the company would become the primary buyer of the farmers involved. This approach woud be appropriate in the case of Strategy Track Two, when an industrial dairy processor is the private sector partner operating the PPP milk collection hub, and sells or uses all of the milk collected in its own processing operations.

Key capacity building topics

The practical, field based capacity building training would focus on key topics which have the potential to have a disproportionately positive influence on productivity and profitability. Several of the principal topics are described below.

1. **Improve feeding practices:** While many farmers in the primary milk production zones know the best methods of feeding – using concentrates, enriched straw, and green roughage – also described in the section on the value chain input feedstuffs, many farmers still do not use good practices. Field research showed farmers substituting too high a proportion of straw in place of green fodder, even when green fodder is available. In other territories, farmers do not know the importance of proper feeding, or how to best mix the feed for the optimal conversion ratios. Farmers will be shown how to calculate the feed required for their animals in different periods, including exposing them to web-based tools for such calculations. One of the constraints to proper feeding is the high cost of concentrates. While homemade concentrate mixes are less expensive than readymade concentrates, they also match less the dietary requirements of the cattle. Further, while even the ingredients of the homemade concentrates are available in local markets, the prices are inflated due to multiple trades and high prices on certain imported products (maize, soy, and other ingredients). The high cost of concentrates is addressed in the feed-for-milk scheme to be operated through the PPP milk collection hub, described in the section on the hub business model.
2. **One calf per cow per year:** Whereas the optimum period between births in the dairy industry is 12 to 13 months, field research showed that the average period in Bangladesh is 15 months, with many farmers delaying further. As noted above, the success rate of artificial insemination depends on many factors, including the ability of the farmer to detect heat, the skill of the AI practitioner, the nutrition and health of the cow, and other factors. Reducing the period between births would reduce the cost of feed per lactation, accelerate the multiplication of assets (bulls to sell for income or heifers to keep to expand the herd), and increases the overall productivity of the cow. Farmers will be sensitized to the benefits and supported to accelerate the calving intervals.
3. **Improve calf care:** As farmers focus on selling milk for income, they do not allow calves to drink sufficient milk for their own nutrition. Additionally, only very expensive imported milk substitutes are available.

While researchers at Bangladesh Agricultural University has worked on developing a milk substitute from local ingredients, it is not market ready. As a result, a large proportion of the calves in the country are malnourished. This malnourishment reduces calf immunity and leads to a death rate among calves of 25% of higher in some regions.[60] Such a death rate, particularly among cross-bred calves, undermines the overall growth of the livestock sector in the country. Additionally, given the tentative profitability of milk farming, the loss of such an asset would make the farmer's business operate at a loss in that year. The NGO SOJAG has been able to reverse the trend of high calf mortality by placing a wooden pallet under the calf in the shed, to keep it out of the often contaminated mud; this simple technology has had a dramatic impact on reducing the death rate and could be promoted in other areas. Equally of concern, is that when calves are malnourished they do not develop to the full potential of their breeds. In females, the mammary gland is forming during the early months, so if the calf is malnourished, her milk production potential will be reduced throughout her lifetime. It is counterproductive to breed larger Holstein-Frisian cross cows, which are more expensive as they consume more feed (per body mass), and are less resistant to local diseases and temperatures, if their milk production potential is curtailed as calves. As a result, the costs of production increase, while revenues from milk sales remain limited.

4. **Improve cattle health:** While in some areas farmers vaccinate their cattle for the primary diseases, and the use of deworming tablets has become common, in other areas far fewer of the cows are vaccinated. While the major diseases, such as FMD, are the most obvious health challenges, these have become endemic and cattle populations have essentially adapted to living with these diseases. Other issues such as parasites, diarrhea, mastitis, and other more preventable diseases reduce the productivity of cattle to an even greater degree. Many of the issues which reduce productivity can be resolved through better nutrition and cleaner conditions for cattle.
5. **Record keeping:** record keeping is the process of measuring the yield and profit, which is of great value for making right decisions. Currently, only a limited number of farmers who have access to additional services are keeping record regularly. Some keep records by themselves, trained by NGO or development organizations through funded projects; others deposit the record booklets in the milk collection centers where the company employees will assist in recording dairy milk supply. The record generally has special focus on daily income but neglects the importance of recording feed and breeding history.
6. **Other relevant topics:** Other technology and capacity building topics, to be implemented on a case-by-case basis depending on identified needs in the field, include the following.
    a. **Fodder production:** Since fodder production is widespread (at least in most of the milk production zones) the technology is widely known, and cuttings for on-farm production are available. Additionally, the primary barrier to additional fodder production is not the lack of knowledge or inputs, but a lack of available land. When land is available, and when farmers are unfamiliar with the technology, the 3ADI+ platform partners will diffuse the technology.
    b. **Silage production:** Silage production is a relatively unused technology, since in most cases sufficient fodder is not available in the lean season to make into silage. Additionally, most areas lack storage space. Additionally, leakage presents an environmental hazard, particularly in a country with monsoons and so much water. However, as silage preserves the maximum of nutrients in the green fodder, when conditions are suitable for silage production, the technology can be promoted to farmers.
    c. **Feeding related technologies:** Although these technologies are known among larger farmers, and machines are available in Bangladesh, many small farmers lack access to total mixed ration (TMR) wagons, choppers and other machines. In the case that the use of these machines could be

[60] A calf death rate of 27% was reported by the NGO SOJAG, in Dhamrai Upazila in Dhaka.

adopted by a farmer association, they will be promoted. Once a farm has progressed beyond the low input feeding method of giving cattle household scraps and rice straw only, with periodic tethered grazing in harvested fields, and has begun to feed cows with concentrate and green fodders, various farm machines can be used to optimize feeding practices. Although straw has virtually no nutritional value, it is an integral part of the diet of many cows in Bangladesh. Using a manual or mechanical chopper, straw can be chopped and mixed with other ingredients, including usually molasses, to improve the nutritional quality. Green fodder is better digested chopped as well. Additionally, by preparing Total Mixed Ration (TMR), using a mixing wagon, a home-made feed containing all of the components needed by the cows for good nutrition can be prepared. Cows consuming TMR have been shown to have a 5% increase in milk production, due to having a more balanced diet. These machines will be introduced to the farmers with a sufficiently high productivity level, and made available to larger individual farmers or groups on a matching grant basis, sold through the Diary Hubs.

d. **Biogas digesters:** While in some regions dung is sold or used, in other regions, farmers report challenges in disposing with dung. When appropriate, the 3ADI+ platform partners will introduce biogas digesters to be managed at the level of farmer cooperatives – to reduce the volume of the dung, and to transform it into high quality fertilizer, and to capture gas for home uses – thus also mitigating the environmental hazard.
e. **Housing designs to reduce disease, parasites, and heat stress:** Although the local nondescript cattle are usually kept low mud buildings, without space for ventilation, and given water only when mixed with straw, such conditions would severely reduce the productivity of cross-bred cows, and even increase the chances of these animals dying. Climate resilient housing models will be developed based on successful practices introduced by DLS and other actors (NGOs and companies), which include high ceilings for ventilation; proper tethering positions; separate areas for movement, washing and milking; separate feed and water areas; collection areas for dung and wastes; and for some larger-scale farms, solar powered fans and/or sprinkler systems. They will be designed for easy disinfection to prevent mastitis, other diseases, and external parasites. Considering the depreciation value of such housing over 10 years on straight-line basis, the investment will be shown well worth the impact.
f. **Improved farm management techniques:** The farm management practices of Bangladesh's farmers need improvement, to ensure not only for maximum milk output, but also to maximize farm profitability. As discussed in section 3.4.2 on Primary Production, farmers in different production systems and in different farm size categories, follow the best practices in farm management to varying degrees. In small farms, the constraints of poor management and low cow productivity often result in farmers operating their livestock activities at a loss. The additional labor costs when operating at scale also threaten the profitability of the mid-sized farms. Beyond the feeding, housing and veterinary practices already described, a number of good practices need to be adequately observed in order to ensure dairy farm profitability at all levels. Such practices include a faster schedule of calf birthing, preventative health measures against mastitis and other threats, timely sales of bulls to purchase heifers, and other management techniques. While proper decision-making regarding such practices has a significant impact on profitability, most farmers even in the primary milk production zones do not comply with all of them, few of the farmers out of the milk production zones are unknowledgeable about such techniques. The farm business models will show the impact of using and not using improved management techniques over the lifetime of a cow. Farmers will also be encouraged to keep record books, to record their

purchases and practices, enabling them to understand the techniques that lead to higher profitability, and be incentivized to maintain good practices.

Community based animal health promotion

Facilitate self-monitoring of animal health: another key aspect is that the members of the associations would provide support to each other to be vigilant on maintaining animal health at the community level, which would include ensuring that each member meet the proper vaccination schedules and vaccinate for all of the possible diseases, keep their stables and sheds clean and hygienic to prevent against other sources of parasites and diseases, and conduct some monitoring of the entry and exist of new animals into the community. While it will be impossible to establish disease free zones in the communities, the underlying conditions of better disease control can be established, and could be further developed over time. If in the future, the conditions for a community policed disease free zone could emerge, the foundation would have been laid.

***Veterinary support systems*:**

The high incidence of infectious disease among cattle has a dramatic impact on milk production. Cattle deaths are not uncommon among all farm sizes. While DLS's extension system covers the high milk producing zones and upazilas (sub-districts), and farmers in these areas report satisfaction with the availability of veterinary services, coverage in emerging milk zones and areas outside of these focus areas, is woefully inadequate. Additionally, even when veterinary coverage is sufficiently intense, vaccination drives and other animal health initiatives meet with only moderate success due to the lack of participation of farmers and difficulty monitoring the entrance of sick animals into a community. 3ADI+ and its partners will train Livestock Health Workers at the level of the farmer associations, to provide veterinary and AI services, who will be linked to the DLS extension system. The farmers' associations will also provide voluntary monitoring and encourage members to get vaccinations and treatments for parasites on the recommended schedule. They will also encourage members to keep records of each treatment, and jointly analyze the information to take prompt action against the most common diseases.

Feed-for-milk scheme

The role of the associations would be recognized, particularly as the primary production segment partners which would be engaged in the feed-for-milk scheme to be operated by the PPP milk collection hubs. Farmers will benefit from the logistics and resources provided and have more financial benefits of participating in the scheme.

Artificial insemination and veterinary services

The current system of delivery of vaccination, veterinary services and AI is robust and decentralized, operated by DLS, NGOs, private companies and other actors. The services provided by various actors complement each other, and widely cover the country.

For AI, as it has been the focus for a few decades (especially since the 2007 strategy), the way of promoting and delivery can continue as it is but would not be the main focus for 3ADI+ as from a value chain perspective demand for milk and meat is basically satisfied. However, as AI increases the profitability of the breed, there is a need to focus on improving practices and improving quality within the zones and with the cross-breeds.

As for animal health, farmers need to be trained on animal disease prevention and identification for timely treatment, in order to reduce their losses. Creating more demand for disease free milk and cattle will create more demand for better services, however, continuing to provide services to the vast and unorganized producer segment would not result in any changes. Therefore, 3ADI+ should focus on shifting the market structure to demand safer and higher quality products and organize the farmers so that the existing actors can provide services more efficiently.

While the public sector (DLS) struggles with its limited resources and manpower to respond to the number of cattle requiring services, the private sector and individuals respond to the demand of a paying class of livestock farmers. Therefore, nowhere is there a true undersupply and gap in demand for livestock and AI services. Quality is another aspect, which may not be involved, but is also in response to the ability pay. In areas that farmers have local cows, there are fewer services available, but there is also low demand for services, as farmers generally do not vaccinate local cows and many may prefer natural insemination. Demand for veterinary and AI services is concentrated in the areas with cross-breed cows of around 50% exotic blood. Another challenge is the low profitability of livestock rearing. When income from the activity is so low, particularly when they rear local cows or are first entering the business of having cross-breed cows, so even if they have demand for services they may not be able to pay. This is the case when the public sector services, and not any private sector service provision as could potentially be supported by 3ADI+ is required. Therefore, 3ADI+ efforts to boost the effectiveness of animal health and AI service delivery focus on facilitating and making the services delivered by the government (DLS) more efficient, by forming livestock farmer associations. The associations serve as an organizing principle around an approach requiring cohesion and consensus from members, and will more easily facilitate the delivery of services at the group level, than DLS's current approach of providing services on an individual level, or promoting vaccination drives through religious authorities, who help by informing individuals.

Financial results of milk production: traditional approaches compared to improved farm management

The cost benefit statements below show financial results for four varieties of cow under the traditional production system, improved production system, and the improved production system, but with concentrate feed costs reduced by the farmer's participation in the feed-for-milk scheme to be implemented through the PPP diary collection hubs. The improved system scenario includes many of the benefits which would be gained through the improved capacities of farmers in livestock management, which would result from the better organization and practical training described above.

The varieties of animals included in the tables are the local nondescript breed, a cross-bred local with Holstein-Frisian cow with 37.5% exotic blood, a cross-bred local with Holstein-Frisian cow with 62.5% exotic blood, and a cross-bred local and Sahiwal cow.[61] Sahiwal is a cattle race which originates from Pakistan, and for which semen is available through DLS and other artificial insemination programs. While pure Sahiwal in theory do exist in Bangladesh, due to the indiscriminant breeding of Sahiwal and other local varieties, in actuality it is impossible to discern the percentage of local cow and Sahiwal blood in any given animal.

The traditional scenario, shows good practices being used, such as adequate feeding and use of vaccinations. This scenario also shows the costs over 15 months, as in practice most cows give birth every 15 months in Bangladesh. This reduces the profitability as the amount of milk produced does not increase, while the cows require to be feed during a longer non-productive time. In some cases, the actual scenario is worse than the traditional scenario. The improved scenario shows the use of best practices for feeding and animal health. The feeding costs are over 12 rather than 15 months, as the farmer in the improved scenario follows the best breeding practice of one calf per year.[62] The cost in the improved scenario also show the adequate feeding and care of the calves. The improved

[61] Cost benefit information is also available for 25% and 50% local and Holstein-Frisian cross-breeds.

[62] While in this case, the traditional and improved scenario compare timeframes of 12 and 15 months, however, the revenue during this time is the same. It is critical to note the additional costs from not following a one-year-one-calf farm management policy. No literature was found correctly reflecting these additional costs, and therefore the profitability of cattle farming is consistently overstated. The cows of many farmers, particularly in rural areas, give birth with an interval of more than 15 months.

scenario with the hub system is also shown, which includes only the less expensive feed provided through this scheme.

Regarding the revenue categories: The statements estimate the amount of milk provided by each animal, under each scenario, using the production in liters per day and the corresponding length of the lactation cycle. The producer milk purchase price of 39 BDT/liter is shown in the table, which is representative of a price that the industrial dairies pay to farmers. The industrial dairy price varies between 35 BDT/liter and 40 BDT/liter for milk with an average fat content of 4%, with the variation based seasonality. The cash income from dung sales has been estimated at 10% of the value of the dung, as most farmers do not sell all of the dung produced, but do use it on their own fields as fertilizer. The revenues from the sale of calves is adjusted to represent the sale of a male calf every other birth, and the retention of a female calf every other birth. The cow is sold for slaughter after her milk production declines. Revenues from culled animals are allocated to the period shown in the statement, and counted in the income as non-cash income, as the cash is not received in the same period.

Regarding the cost categories: No cost is included for the purchase of the cow, as the livestock development works through artificial insemination. Thus, the assumption is that the cow was born on the farm and not purchased. Feeding costs are adjusted based on the size of the animal and the amount of milk produced, and also take into consideration feeding rations for lactating periods, non-lactating periods and for calves. Costs such as the depreciation expense on housing, vaccination services, and others, have been estimated based on the needs of each animal type and the typical amounts spent by farmers – determined through field surveys and research with experts.

The profits section, shows profits based on cash income and non-cash income, which take into consideration the sale culled animals and depreciation. Losses are shown in red. The cells in yellow in the profits section, show the results which continue to be negative, even when the milk sale price is increased to 50 BDT, as is the case in some areas and was more often the price historically.

The 3ADI+ stakeholder platform will support about 15,000 farmers in the industrial dairy value chain and 15,000 farmers in the traditional dairy value chain to learn and apply the practices discussed. The tables below use the milk price paid to farmers by industrial processors. In zones with increasing or high milk production, traditional processors pay a higher price, as they do not provide the same logistical services and embedded services. As a result, the profitability of farmers supplying primarily traditional processors can be higher. On the other hand, in zones with low milk production, and no industrial processor collection systems, traditional processors often pay reduced prices. In most milk zones, processors supply both traditional and industrial processors. When evaluating the farmers supplying to industrial or traditional processors for the 3ADI+ program, the implementing partners will consider the zone – whether it is a zone primarily for industrial collection or whether it is a sweetmeat cluster – and the primary buyers of the farmers.

Table 32: Cost benefit statement for local and 37.5% cross breed cow in traditional system, improved system, and improved system with feed-for-milk scheme implemented through PPP milk collection hub

			Local			Local x HF 37.5% foreign blood		
	Farm management	Unit	Traditional	Improved	With hub scheme	Traditional	Improved	With hub scheme
REVENUES								
Annual milk sales								
	Liters of milk produced	Liters	270	660	660	1,225	1,755	1,755
	Price (average of buyers and seasons)	Tk/liter	39	39	39	39	39	39
	Cash revenue from milk	**Tk**	10,530	25,740	25,740	47,775	68,445	68,445
Annual dung sales								
	Potential value of dung	Kg/day	5000	7000	7000	7,000	8,000	8,000
	% sold	%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
	Cash revenue from dung	**Tk**	500	700	700	700	800	800
Annual calf sales								
	Calf sale price	Tk	30000	33000	33000	35,000	40,000	40,000
	Frequency of calf birth	Months	15	12	12	15	12	12
	Calf sale price allocated to the financial year	**Tk**	18,750	16,500	25,000	18,750	20,000	25,000
Annual income from old cow sales								
	Old cow sale price	Tk	30000	33000	33000	35,000	40,000	40,000
	Age when cow no longer productive	Years	8	6	6	8	6	6
	Old cow value (non-cash in the financial year)	**Tk**	4,000	5,500	5,500	4,667	6,667	6,667
Total cash revenues in the year		**Tk**	11,030	26,440	26,440	48,475	69,245	69,245
Total revenues allocated to the year		**Tk**	38,280	54,740	63,240	78,192	103,112	108,112
COSTS								
Cost of purchase of cow								
	Cost allocated to financial year	Tk	0	0	0	0	0	0
Cost of feeding - Cow and calf								
	Concentrates	Tk/year	7,673	19,305	15,795	34,403	44,798	36,653
	Green fodder	Tk/year	9,900	9,684	9,684	11,520	14,784	14,784
	Dry straw	Tk/year	1,350	7,470	7,470	10,350	11,115	11,115
	Total feeding cost of cow and calf	**Tk/year**	**18,923**	**36,459**	**32,949**	**56,273**	**70,697**	**62,552**
Other costs of production								
	Services: AI, veterinary, medicines & treatment	Tk/year	2,000	2,500	2,500	3,000	3,000	3,000
	Labor cost allocated to cow and calf	Tk/year	0	0	0	0	0	0
	Utilities and other allocated to cow and calf	Tk/year	250	250	250	500	500	500
	Depreciation on housing, tools & machines	Tk/year	1,400	1,600	1,600	3,000	3,400	3,400
	Annual interest paid on loans	Tk/year	0	0	0	0	0	0
Total cash expenses in the year		**Tk**	21,173	39,209	35,699	59,773	74,197	66,052
Total expenses allocated to the year		**Tk**	22,573	40,809	37,299	62,773	77,597	69,452
PROFIT								
Cash basis		**Tk**	**-10,143**	**-12,769**	**-9,259**	**-11,298**	**-4,952**	**3,194**
	Profit margin	Tk	-92.0%	-48.3%	-35.0%	-23.3%	-7.2%	4.6%
Cash and non-cash basis		**Tk**	**15,708**	**13,931**	**25,941**	**15,419**	**25,515**	**38,660**
	Profit margin	Tk	41.0%	25.4%	41.0%	19.7%	24.7%	35.8%
Milk production cost/liter		Tk	84	62	57	51	44	40
Profitability of milk sales/liter		Tk	-12,043	-15,069	-11,559	-14,998	-9,152	-1,007
	Profit margin/liter (milk only)	Tk	-114.4%	-58.5%	-44.9%	-31.4%	-13.4%	-1.5%
VC IMPLICATIONS AND DEVELOPMENT OUTCOMES								
Difference in value (cash and non-cash)			**Traditional to improved**	**Improved to hub scheme**	**Traditional to hub scheme**	**Traditional to improved**	**Improved to hub scheme**	**Traditional to hub scheme**
	One cow	Tk	-1,777	12,010	10,234	10,096	13,145	23,241
	1,000 cows	Tk	-1,776,500	12,010,000	10,233,500	10,096,000	13,145,000	23,241,000

In the case of the local nondescript cow, the cash basis results show a loss in each scenario, whether the farmer sells the milk at the purchase price of the industrial dairies, or at 50 BDT/liter. Counting non-cash earnings (including the sale of culled animals and counting the value of the dung), profits are positive in all scenarios. In reality, most rural farmers which have the nondescript local cows feed only household wastes and tether the cows to eat the rice stubble left after harvest in fields. They also do not vaccinate the animals. Therefore, in the costs are reduced to near zero. However, in this case, the milk production is also greatly reduced, and serves only for family consumption. The only cash income is the sale of the calf, and possibly the cow. This production system is not commercial and does not lead to economic development for the family of overall economy.

In the case of the cross-bred cow with 37.3% exotic blood, cash basis results are negative at the industrial dairy purchase price for milk, in the tradition and improved scenarios. This breed only becomes profitable on a cash basis, when engaged in the feed-for-milk scheme which reduces the cost of concentrate feed. As with the purely local cow, all scenarios yield a gain when income for future sales is allocated to the current period, as the "non-cash" results. As mentioned earlier, the profitability of livestock rearing in Bangladesh is dependent on the sale of culled animals. However, that farmers lack a timely cash income from the activity is problematic to the growth of the livestock sector. A small-scale farmer may be forced to sell even the female calf born of a 37.5% cross-bred cow, if the cash income is not enough to finance the activity. Selling the female calves prevents that farmer from expanding his/her herd with more productive cross-bred animals.

The table below shows the same situation for 62.5% cross-bred cows, as well as Sahiwal. While the breeding policy of Bangladesh stipulates a target of 50% exotic blood in cross-bred cows. However, the ideal breed mix for the climate of the sub-region, which is also used in India's livestock policy, is 62.5%.

Even the 62.5% cross-bred cow results in a loss on a cash basis in the traditional system, using the prices paid by the industrial dairies. Therefore, farmers with the optimal cow will even face cash pressures under the traditional system. However, as also shown in the table the additional earnings generated by the farmers operating according to the improved system, within the hub scheme, is 43,972 BDT, the equivalent of about 600 USD per lactation period. The difference between the 62.5% cross-breed in the improved scenario within the hub scheme, and the local cow in the traditional scenario is 53,766 BDT, equivalent to nearly 740 USD.

As shown in the table, the Sahiwal is less advantageous from an economic perspective than the 37.5% Holstein-Frisian cross-breed. It is more advantageous however than a 25% Holstein-Frisian cross-breed. Additionally, the Sahiwal has other benefits not captured in the economic analysis, including better disease and heat resistance in Bangladesh's climate, and a local preference for its meat.

Table 33: Cost benefit statement for 62.5% and Sahiwal cross breed cow in traditional system, improved system, and improved system with feed-for-milk scheme implemented through PPP milk collection hub

			Local x HF 62.5% foreign blood			Shaiwal x Local		
	Farm management	Unit	Traditional	Improved	With hub scheme	Traditional	Improved	With hub scheme
REVENUES								
Annual milk sales								
	Liters of milk produced	Liters	1,960	3,000	3,000	945	1,440	1,440
	Price (average of buyers and seasons)	Tk/liter	39	39	39	39	39	39
	Cash revenue from milk	**Tk**	76,440	117,000	117,000	36,855	56,160	56,160
Annual dung sales								
	Potential value of dung	Kg/day	10,000	12,000	12,000	7,000	9,000	9,000
	% sold	%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
	Cash revenue from dung	**Tk**	1,000	1,200	1,200	700	900	900
Annual calf sales								
	Calf sale price	Tk	50,000	50,000	50,000	35,000	40,000	40,000
	Frequency of calf birth	Months	15	12	12	15	12	12
	Calf sale price allocated to the financial year	**Tk**	18,750	25,000	25,000	18,750	20,000	25,000
Annual income from old cow sales								
	Old cow sale price	Tk	50,000	50,000	50,000	35,000	40,000	40,000
	Age when cow no longer productive	Years	8	6	6	8	6	6
	Old cow value (non-cash in the financial year)	**Tk**	6,667	8,333	8,333	4,667	6,667	6,667
Total cash revenues in the year		**Tk**	77,440	118,200	118,200	37,555	57,060	57,060
Total revenues allocated to the year		**Tk**	111,857	162,333	162,333	67,272	91,827	96,827
COSTS								
Cost of purchase of cow								
	Cost allocated to financial year	Tk	0	0	0	0	0	0
Cost of feeding - Cow and calf								
	Concentrates	Tk/year	50,655	62,370	51,030	28,710	39,600	32,400
	Green fodder	Tk/year	12,600	16,020	16,020	12,600	10,560	10,560
	Dry straw	Tk/year	11,700	12,210	12,210	11,700	9,660	9,660
	Total feeding cost of cow and calf	**Tk/year**	**74,955**	**90,600**	**79,260**	**53,010**	**59,820**	**52,620**
Other costs of production								
	Services: AI, veterinary, medicines & treatment	Tk/year	6,000	8,000	8,000	2,500	3,000	3,000
	Labor cost allocated to cow and calf	Tk/year	0	0	0	0	0	0
	Utilities and other allocated to cow and calf	Tk/year	1,000	1,000	1,000	500	500	500
	Depreciation on housing, tools & machines	Tk/year	4,400	4,600	4,600	2,800	3,000	3,000
	Annual interest paid on loans	Tk/year	0	0	0	0	0	0
Total cash expenses in the year		**Tk**	81,955	99,600	88,260	56,010	63,320	56,120
Total expenses allocated to the year		**Tk**	86,355	104,200	92,860	58,810	66,320	59,120
PROFIT								
Cash basis		**Tk**	**-4,515**	**18,600**	**29,940**	**-18,455**	**-6,260**	**940**
	Profit margin	Tk	-5.8%	15.7%	25.3%	-49.1%	-11.0%	1.6%
Cash and non-cash basis		**Tk**	**25,502**	**58,133**	**69,473**	**8,462**	**25,507**	**37,707**
	Profit margin	Tk	22.8%	35.8%	42.8%	12.6%	27.8%	38.9%
Milk production cost/liter		Tk	44	35	31	62	46	41
Profitability of milk sales/liter		Tk	-9,915	12,800	24,140	-21,955	-10,160	-2,960
	Profit margin/liter (milk only)	Tk	-13.0%	10.9%	20.6%	-59.6%	-18.1%	-5.3%
VC IMPLICATIONS AND DEVELOPMENT OUTCOMES								
Difference in value (cash and non-cash)			**Traditional to improved**	**Improved to hub scheme**	**Traditional to hub scheme**	**Traditional to improved**	**Improved to hub scheme**	**Traditional to hub scheme**
	One cow	Tk	32,632	11,340	43,972	17,045	12,200	29,245
	1,000 cows	Tk	32,631,667	11,340,000	43,971,667	17,045,000	12,200,000	29,245,000

4.3.2 Village milk collection centers (business model 2)

Description of the intervention

Particularly in the emerging milk zones, which have experienced less influence and distortion from the collection systems of the industrial dairies, the collection systems will generally be functioning in equilibrium with supply. Therefore, interventions to increasing milk production from cows, need to be accompanied by market system developments capable of absorbing the additional milk supply. If milk collection systems do not expand in parallel with the increase in production, producers will have difficulty selling their milk, they will be unable to finance the costs of the more expensive cross-breed cows, and they will in turn stop investing in the quality and quantity of their milk. Thus, initial gains in boosting milk production will be lost and the livestock sector farmers will remain at the subsistence level.

Therefore, in the territories targeted for increasing milk production the 3ADI+ platform will support entrepreneurs to establish village milk collection centers in proximity to the livestock farmers. These territories will generally be in emerging milk zones, where industrial processors collect milk, but where their collection systems are generally too distant to serve the majority of livestock farmers. The VMCCs could initially extend the collection systems of the industrial processors to open accessible milk markets to the livestock farmers in the area. However, the objective is that they would supply milk to the PPP milk collection hubs, proposed as an intervention by 3ADI+.

As the milk collection center model is used by several of the industrial processors, and can be found operated by entrepreneurs and independent agent collectors, the business model is not an innovation. The objective of the intervention is to replicate a proven and profitable unit of the overall milk collection system in the country, to expand the market system into new and emerging milk zones. This approach scales an existing model for greater impact.

Partnership and modality of implementation

A key partner of the 3ADI+ stakeholder platform will lead the support to entrepreneurs or cooperatives to launch VMCCs in the targeted territories of the project. A selection methodology to identify capable and experienced entrepreneurs, with an emphasis on young people and women, will be designed and implemented in these localities. The implementing partner will support the entrepreneurs to study the local market and potential buyers, and to adapt the business model included in the Annex to the specific case. Support will be provided in identifying, procuring, and installing milk testing and cooling equipment. Entrepreneurs and their staff will be trained on various technical and business topics related to operating the collection centers, and provided ongoing support in business planning and operations.

Implemented as a matching grant of equipment and advice, while the entrepreneur will make investments to secure land and to construct or renovation a building for the collection center. The entrepreneur will also secure the necessary working capital, which will be a small amount, as farmers are paid every two weeks after supplying their milk. Therefore, working capital is essentially supplier financed by the farmers, with fast turnover. Entrepreneurs could compete for more milk from farmers by offering more favorable terms. The 3ADI+ implementing partner will support with linking entrepreneurs with financial institutions, where they will be able to present their business models, in case the entrepreneur otherwise does not have access to the required capital, land or structures.

Key infrastructure and technology investments

The following table shows the investments to launch a fully equipped VMCC, together with mobile phones for the three attendants, and motorbike for entrepreneur mobility and to visit farmers. Food grade milk cans to distribute to the farmers supplying the center are also included in the costs. The total cost of 2.6 million BDT, equivalent to

less than 40,000 USD, represents the best case scenario, meeting all food safety standards. VMCCs requiring less initial investment could also be envisioned, with additional investments made from the generated profits.

Table 34: Investments in infrastructure, equipment and land for a milk collection center

CAPITAL INVESTMENT	Cost (US$)	Cost (BDT)	Number	Total cost (BDT)
Milk collection and chilling				
Chilling tank	10,000.00	730,000.00	1	730,000.00
Milk cans	60.00	4,380.00	250	1,095,000.00
Water pump	200.00	14,600.00	1	14,600.00
Milk delivery pump	400.00	29,200.00	1	29,200.00
Generator	3,500.00	255,500.00	1	255,500.00
Gysser	160.00	11,680.00	1	11,680.00
Change over switch	27.00	1,971.00	1	1,971.00
Electric sub meter	12.00	876.00	1	876.00
Electric wire and accessories	142.86	10,428.57	1	10,428.57
Steel Sink	20.00	1,460.00	1	1,460.00
Centrifuge machine (laboratory)	140.00	10,220.00	1	10,220.00
Submersible pump	200.00	14,600.00	1	14,600.00
Gazi tanks	70.00	5,110.00	1	5,110.00
Steel sink stand	9.00	657.00	1	657.00
Gazi tank stand	95.00	6,935.00	1	6,935.00
Plastic chairs	20.00	1,460.00	3	4,380.00
Motor bike	2,000.00	146,000.00	1	146,000.00
Ceiling fans	30.00	2,190.00	1	2,190.00
Mobile phones	25.00	1,825.00	3	5,475.00
Table	20.00	1,460.00	1	1,460.00
Lab equipment	2,000.00	146,000.00	1	146,000.00
Electricity installations	1,500.00	109,500.00	1	109,500.00
Total				**2,603,242.57**
Land and structures				
Construction/structure of hub	2,000.00	146,000.00	1	146,000.00
Land of hub	2,000.00	146,000.00	1	146,000.00
Total				**292,000.00**
Totals				**2,895,242.57**

Source: Adapted from PRAN Dairy

Business model for a milk collection center

With a 2 ton/day capacity, and operating near capacity, and with seasonal decreases in milk collection up to 25% during the lean season, the collection center generates annual net profit of 1.4 million BDT, equivalent to nearly 19,000 USD, and cash flow of 1.6 million BDT, or over 22,000 USD. These statements do not incorporate interest on loans which the entrepreneur may borrow as his/her matching portion of the investment. Investments in equipment are also not shown, but will be included in the case specific business plans. Full financial statements showing the evolution of the business results, with the business operating near capacity, are included in Annex XXX.

The MCCs earn a very small profit per liter, simulated here as 1 BTD/liter retained as gross profit, and 1 BDT/liter as a commission from the processor buyer. However, operating at volume, the business is profitable, with a slim profit margin of just over 5%. The purchase of fresh milk makes up 87% of the costs of the business. The support provided by 3ADI+ in investing in equipment and laboratory testing, will be instrumental in allowing these entrepreneurs to launch, without incurring heavy capital costs. These costs are currently reflected in the depreciation expense.

Table 35: Annual financial results for milk collection center operating near capacity (2 tons/day), in BDT

INCOME STATEMENT		Annual
REVENUES		
	Fresh milk sales	26,026,500
EXPENSES		
Cost of Goods Sold		
	Fresh milk purchase	22,710,000
Gross profit		**3,316,500**
Operational expenses		
	Chilling overhead (electricity, water, etc.)	301,500
	Milk transport price VMCC to hub	904,500
	Commission paid to collector/suppliers	180,900
	Labor/salaries cost (2-3 people)	301,500
	Total operational expenses	**1,688,400**
Depreciation on capital investment		
	Depreciation	267,624.26
Financing		
	Interest expense	0.00
Total expenses (operational, depreciation, financing)		1,956,024
PROFIT		
Profit		1,360,476
	Profit margin	5.23%
	Operational costs as % of revenue	1.16%

CASH FLOW STATEMENT		Annual
Cash flow from operating		
	Profit	1,360,476
	Plus non-cash depreciation	267,624
	Less increase in working capital	0
	CFO	1,628,100
Cash flow from investing		
	Procurement of PP&E	0
Cash flow from financing		
	Issuance/repayment of loans	0
Cash flow		
Net cash flow		1,628,100
Cumulative cash flow		1,628,100

Source: consultant financial modeling

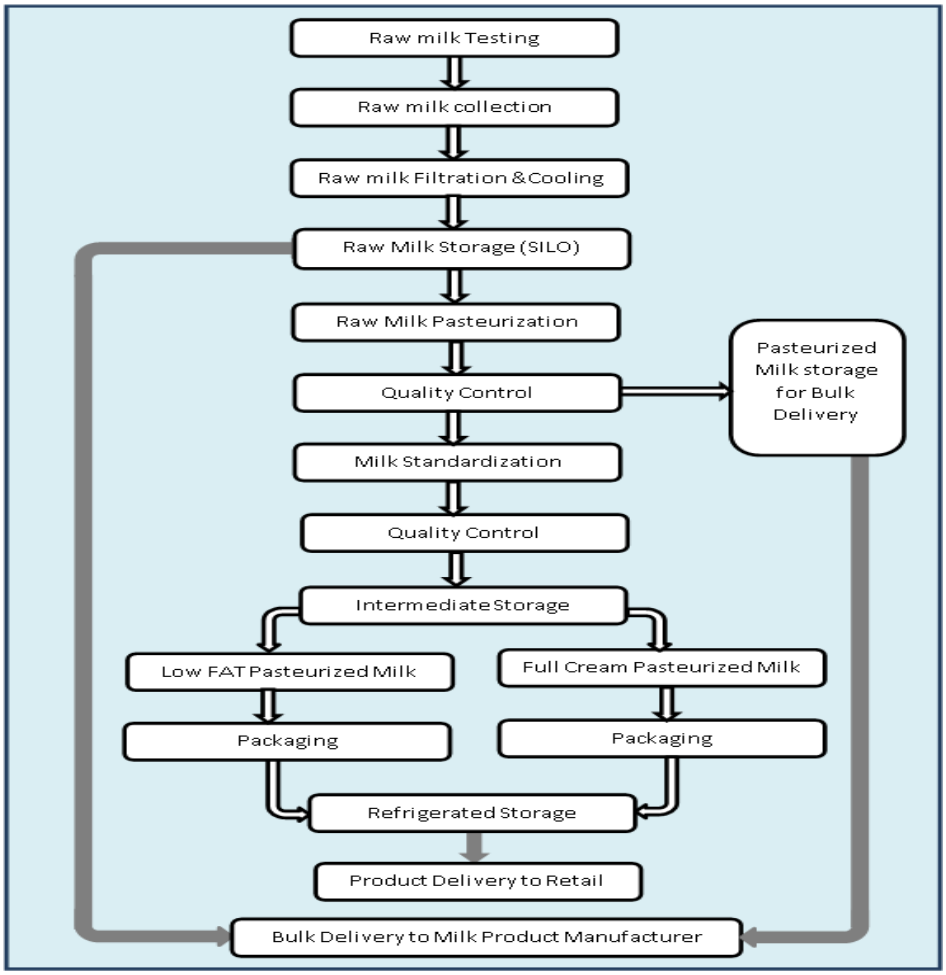
4.3.3 PPP milk collection hub (business model 3)

Description of the intervention

The 3ADI+ stakeholder platform will support the establishment of a Public Private Partnership (PPP) to facilitate milk collection and sales, in the secondary and emerging milk zones. The PPP milk collection hub, with a proposed capacity of 30 tons/day will purchase milk from 15 VMCCs run by independent entrepreneurs (and/or farmer cooperatives), also launched within the context of 3ADI+. It could also purchase milk from existing MCCs or large farmers in the area. The primary objective will be to bulk the milk produced in the region to enable sales of large quantities of milk to larger buyers in other regions of the country, including the Dhaka-based factories of the industrial dairy processors. However, in order to respond to buyer needs with the product-type demanded by the market, the facility will have the capacity to pasteurize the milk, as well as to package it for retail sales. Pasteurizing the milk before transporting it long distances (especially given to poor road quality and delays due to traffic), prevents the growth of bacteria during longer transport trips. The PPP milk collection hub will have the capability to sell milk to processors anywhere in the country, whether they be industrial processors, larger traditional processors, distributors, or retail chains.

The diagram below shows the process flow of the PPP milk collection hub, demonstrating its capability to receive and sell fresh unpasteurized milk, as well as pasteurized low fat of full cream milk, and packaged milk.

Figure 16: Process flow for PPP milk collection hub



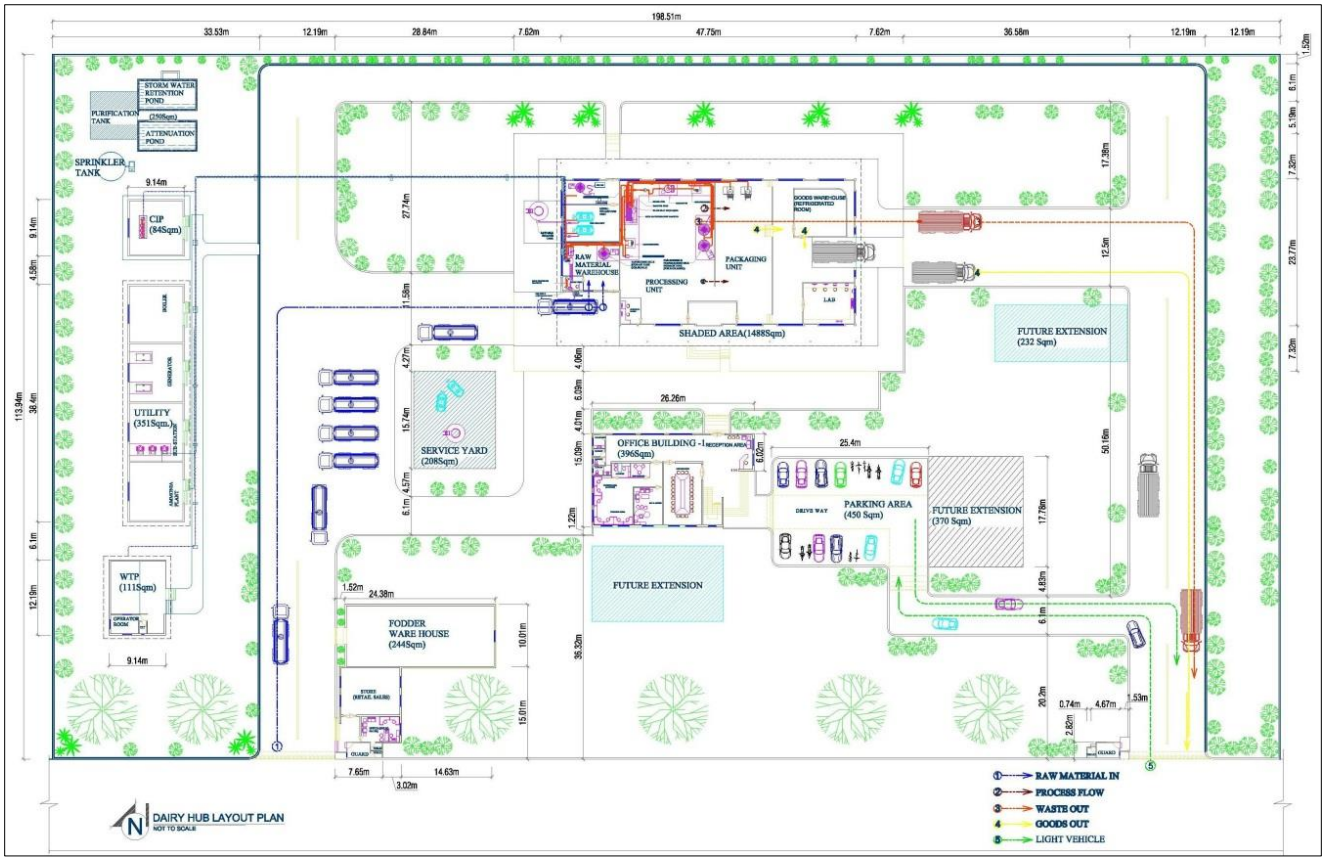
Source: industry research and consultant engaged by 3ADI+

In addition to the milk storage, pasteurization and packing factory, other infrastructures of the hub complex would include an internal road; an effluence treatment plant (ETP); a cleaning in place unit (CIP); a utility building with boiler, backup generator, electricity substation, and ammonia plant; a water treatment plant (WTP), a security guard room, a retail sales area for fodder (concentrate feed) and a fodder warehouse, an office building, parking, a service yard, and space for future extension. The diagram below provides a possible layout for a PPP hub, which could be adapted to the specific sites selected for construction.

In all, the hub would have the following essential facilities.

1. Raw Milk Reception –
    a. Two type of reception:
        i. Tanker reception– Milk is unloaded from Tank after requisite quality check by pump and hose pipe. The milk goes through the clarification (inline piped filtration to remove sand or any solid impurities) process before being pumped to the chilling tank prior to pasteurization process.
        ii. Canned reception – Milk is carried by relatively big individual dairy farmer or middlemen using their own milk can to the Hub. After quality check (from in-house laboratory) these are collected after primary filtration (to separate sediments) in the dump tank. Using pumps milk is then passed to the Chilling Tank after clarification (inline piped filtration to remove sand or any heavy impurities).
2. Silo – A 50000 liter capacity silo for pre-processed raw milk storage after filtration and chilling but before pasteurization process starts. Bulk raw (non-pasteurized) milk buyer (producing various milk products like cheese or sweets etc.) will get their milk from this silo transported by insulated tanker.
3. Processing Hall – Chilling Tank, homogenizer, pasteurizer, standardization, packaging and other related machinery are installed. Milk are pasteurized and according to sales plan are forwarded to either to Pasteurized Milk storage tank (for buyers who only buys pasteurized milk in bulk transported by tanker)or to Standardization (for producing low fat and full cream milk) and packaging.
4. Packaging area – for packing of processed standardized liquid milk of low fat and full cream milk.
5. Refrigerated storage – for keeping the milk and milk products before sending to market.
6. Quality Control Laboratory – for testing the quality of milk and milk products in various stages of production.
7. Utilities area – for installing boiler, backup power generator set, ammonia cooling plant, water treatment plant (WTP), maintenance and store area for spares.
8. ETP – Waste water treatment plant area for treating the dairy effluents before releasing to the fields.
9. Office – for all the administrative and essential staff.
10. Vehicle parking area – for the milk procurement, distribution and visitor vehicles.
11. Retail (Fodder Sale) – for providing veterinary service, supply of feed, fodder seeds, etc. to the surrounding dairy farmers.
12. Fodder Warehouse – A 244 m^2 area shed with a holding capacity of 22 tonnage feed (estimated to be a week supply) to be sold in the retail area to the surrounding dairy farmers.
13. Guard room – Security personnel room with closed circuit security camera observation post. A copy of the observation monitor will also be inside the administrative building.

Figure 17: PPP milk collection hub layout plan



Source: industry research and consultant engaged by 3ADI+

The ETP will ensure that the PPP hub has no negative environmental impacts, and holds its operations to a higher standard than most of the milk collection and processing operations in the country.

The PPP hub would also have the following vehicles, to assist with milk collection from the VMCCs, milk delivery to buyers anywhere in the country, and feed delivery to the farmer associations.

1. Five-ton capacity tanker (double hulled, insulated, non-refrigerated)
2. Fourteen-ton capacity tanker (double hulled, insulated, non-refrigerated)
3. Utility pickup truck (1 ton)
4. Covered van/truck (5 ton)
5. Covered van/truck (1.5 ton)

Milk collection and sales function of the hub: The PPP hubs resolve several constraints in the local and national sections of the dairy value chain. The hubs also offer the functional mechanism connecting milk producers in the zones with less penetration by the industrial companies to connect to the national milk market.

The PPP hubs allow the milk collected by the VMCCs to be bulked at scale, so as to enable sales into the industrial/commercial market, by offering the quantities of milk that correspond to their needs. VMCCs cannot operate independently of larger buyers, as the amount of milk collected by the VMCCs is of an insufficient volume to enable sales to larger buyers who require larger volumes. Additionally, it is the larger buyers who have sufficient demand for milk to create the markets necessary to enable producers to increase production quantities per cow. Further, the VMCCs cannot be dependent on the local traditional processors as the market to sell their milk. The

traditional processors currently do not pay for milk based on quality or fat percentage, and so would not value the milk testing performed by the VMCCs to incentivize farmers to feed their cows better in order to become more productive and more profitable. In order to have the desired impact on producers, their buyers (the VMCCs) need to connect to a market demanding a higher quality of milk, and willing to pay based on gradations of quality. This market includes the industrial processors, the larger traditional processors (particularly the chain operations), and in the future, the traditional processors who will receive training through the 3ADI+ intervention. As the hub will have the capability to package milk, it could even sell a packaged product to distributors or retailers. It is important to connect the producers to this channel within the overall dairy value chain which seeks quality milk, pays for graded quality, and reinforces value within the chain.

Additionally, as the PPP hubs are not within the supply chain of a single industrial sector company, their sales are not constrained by the market share of any single company. The milk collected by the hubs can be sold to the range of buyers mentioned. For this reason, the PPP hubs will have wider market opportunities than only those offered by the packaged product market.

Finally, while in general the industrial diaries send the milk collected in the milk zones in the country to their Dhaka based factories, the PPP hub will be unconstrained in the geographical targeting of its sales. As certain regions have elevated local milk prices, the traditional processors in these regions require milk from other areas. The hub will be able to balance regional gaps in supply and demand by establishing operations in milk zones with surplus production and selling to buyers in zones with milk deficits.

Feed-for-milk scheme function of the hub: As a global average, feed makes up 70% of the production cost of livestock rearing. 3ADI+ research revealed that feed accounts for 85-90% of production costs of cross-bred cattle in Bangladesh, with the total costs often exceeding income from milk sales. 60-65% of feed costs are made up of concentrate feed, whether readymade by a factory or homemade. In many cases, the cost of feed exceeds that average when farmers use their own rice residues remaining after harvest as straw and/or also produced their own green fodder. Livestock rearing in an integrated farming system, with at least part of the requirement of straw and fodder produced on farm, substantially increases the profitability of the activity. However, across the country, many farmers also purchase straw and fodder to support their livestock rearing business. As noted, farmers rely on selling culled animals in order to maintain profitability, or at least not suffer continual losses. Often they are forced to sell heifers, which prevents them from expanding their herds, and developing their livestock business activities.

The other elements of the production costs, such as veterinary services, are often minimized by farmers, with some farmers (generally outside of the primary milk zones) forgoing key vaccinations to reduce production costs.

Regarding concentrate feeds, the bulk of farmers purchase the ingredients to mix their own on their farmers, with few using readymade concentrates from feed companies. (The opposite is true in the poultry sector where virtually 100% of farmers use readymade poultry feed.) Homemade feed is less expensive, but also less perfectly formulated for optimized feed conversion ratios in cattle. Readymade feed can be purchased in a variety of quality grades, and so feed conversion ratios are not necessarily ideal in all readymade feed grades either. Low feed conversion ratios increase the costs of production without correspondingly increasing the production of milk or meat, and so undermine profitability.

Since livestock farming is often only marginally, or not at all, profitable for small-scale farmers, any project initiative should strive either to increase their revenues or to decrease their costs.

While the integration into the supply chains of the industrial dairies offers the leading method of dairy sector development, with farmers incentivized to increase their milk quality and properly care for animals, inclusion in

the supply chain of the industrial dairies means agreeing to limited and often decreasing producer prices for milk. In zones where milk has value, the prices prior to the establishment of the industrial diary milk collection schemes were higher. In the emerging milk zones, which are informal and traditional in nature, and disconnected from the national value chain, the entry of the industrial dairies has a slight upward effect on prices. In either case, market prices are determined by supply and demand – whether in the local, informal market, or the national market. Collectors and processors have more influence on the market price than farmers. As milk production has increased in the primary and secondary milk zones, the industrial dairies have overall decreased prices, to control the collection of milk in parallel with their processing needs. A year-by-year increase in prices is not expected.

Therefore, efforts to increase revenues from milk sales can be most affected by increasing the quantities and qualities of milk produced, rather than by expecting any increase in price. The industrial dairies incentivize an increase in both quantity and quality by having a sliding payment scale based on the fat content of the milk, and also by providing embedded services to farmers such as AI and veterinary services, and extension advice.

Increasing the producer price for culled animals (including calves) is not realistic as prices at the time of sale are largely determined by the cattle traders, who are more experienced in evaluating the value of animals and trading. Additionally, the vast and decentralized network of traders would be difficult to influence, not to mention that trading margins are very slim, and influenced by the market price for fresh meat (which is holding steady in real terms). Further, culled animals, although having a relatively higher price in Bangladesh than in other countries of the sub-continent, are virtually a waste product. Therefore, as a semi-byproduct of the dairy industry, the value of calves and other culled animals is unlikely to increase.

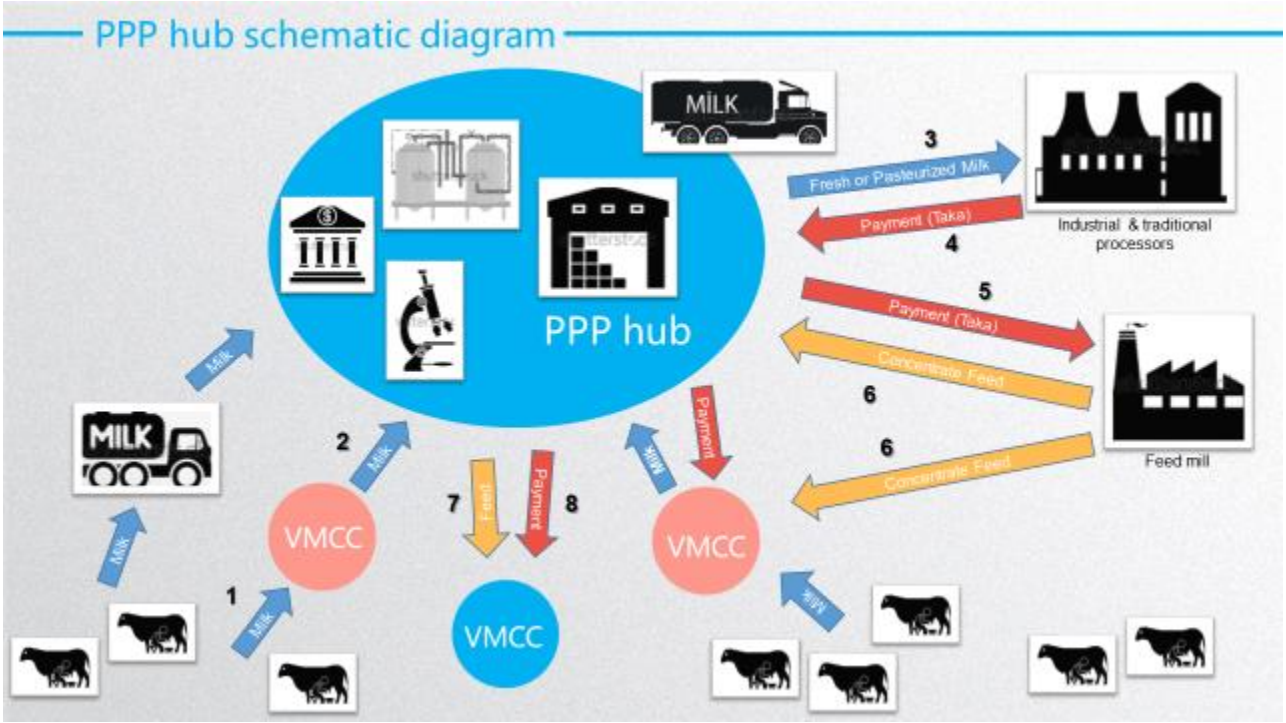
The number of intermediaries and the purchasing of micro-quantities contributes to the high price of animal feed concentrates. Due to the elevated global prices of feed ingredients, the feed manufacturer price cannot decrease. The current price of feeds was maintained even with a decrease in the tariff on the ingredients to feed. Farmers purchase the ingredients for homemade feed at local markets, from retailers who represent the final point on a supply chain of intermediaries, back to the wholesaler or importer. Even readymade feed is sold through dealers, and through smaller dealers in the more remote areas. Although the dealer margins are small, and determined by the manufacturers through the maximum retail price (MRP) mechanism, over the large volume of feed purchased results in high prices for farmers.

The feed-for-milk scheme to be operated by the PPP milk collection hub, will reduce the dealer margin (as the hub will replace the dealer, while also cutting the associated costs and margin), as well as securing the most advantageous wholesale price for concentrate for the farmers. Feed companies incentivize dealers by offering additional discounts based on reaching targets of feed quantities purchased within a month and a year, with further discounts offered for paying in cash up front, as opposed to relying on supplier credit from the manufacturer. By taking advantage of all of these discounts, and further negotiating based on the massive quantities which will be purchased by the hub, the PPP hub will be able to provide farmers with the least expensive price for quality feed.[63] The feed-for-milk scheme mimics the current practices of the farmers, who generally use the earnings from milk to purchase feed and fodder for their animals. The usually make such purchases on a near daily basis.

The operational flow of milk, feed and cash will occur as shown in the diagram, with the steps described below.

[63] As an alternative to readymade feed, the same approaches could be used to purchase the ingredients for homemade feed, to be delivered for mixing to the farmer associations. Such an approach would secure even greater cost savings, while possibly sacrificing the optimal feed conversion ratios. These scenarios will be studied by the 3ADI+ stakeholder platform in the course of implementation.

Figure 18: PPP milk collection hub schematic diagram



1. Farmers deliver milk to their VMCC of proximity on a daily basis, as is usual practice currently where the village-based milk collection centers operate.
2. The PPP hub personnel collect the milk from the VMCC, with the milk usually collected in an insulated tanker truck owned by the hub.
3. The PPP hub sells/delivers to the milk to a larger buyer, either an industrial processor, larger traditional processor, distributor or direct to a retail chain.
4. The PPP hub receives payment in cash at the standard interval agreed by contract.
5. Using the cash, the PPP hub procures concentrate feed at wholesale prices, further discounted as described.
6. The feed company delivers feed to warehouse of hub, or directly to storages of the farmer associations (if the associations have adequate space). It is standard practice in the industry that feed companies delivering feed to their dealers.
7. If the feed is delivered to PPP Hub, then the associations organize rental of truck to pick up feed for members on regular interval. Alternatively, the PPP hub can deliver the feed to the associations. In the business model to follow, the delivery cost of feed to the associations has been included.
8. The feed price (including management and delivery costs and associated fees) is subtracted from the payment owed farmers for milk supplied, and the remaining cash is paid to the farmers through the VMCCs.

Field research showed that feed prices range from 20 to 60 BTD/Kg, with prices below 30 BDT/Kg representing the homemade feed. According to field surveys of 100 farmers in the different regions, the average farmer feed cost is 35.5 BDT/Kg. The final price for readymade feed for the farmers participating in the feed-for-milk scheme of the PPP hub, including transport and other fees, would be around 26.5 BDT/Kg.

Cluster services emphasizing microfinance: The PPP hub contains an additional office space from where a microfinance institution (MFI) could establish services. (Describe situation of financial services – availability for farmers, bull fatteners; ensure is included in enabling environment section.) Operating from the PPP hub offers the opportunity to an MFI to be located in the center of a growing milk cluster. As the farmers in the area will receive support at the level of primary production (through the formation of associations and training) and in market creation (through the VMCCs) for raw milk, the livestock industry will be in a state of growth, and require additional finance to support the expansion. One criteria for selection of the MFI will be that it offers financial products appropriate for livestock rearing, including the new product designed to finance bull fattening recently launched by the microfinance apex organization PKSF.

Other cluster-based services could also be offered from the hub, such as cold storage to improve the effectiveness of vaccines. These services will be analyzed on a case-by-case basis in designing and establishing PPP hubs that respond to the service requirements of the area, in addition to fresh milk market creation.

Partnership and modality of implementation

Each of the PPP milk collection hubs will be constructed and owned by local government, with the operations contracted to private businesses. The 3ADI+ stakeholder platform will support in identifying suitable sites for PPP hubs, which will have the most development impact by facilitating the greatest increases in quality milk production. Support will also be provided to local governments in designing and constructing the hubs, as well as in the search and evaluation of potential private sector operational partners. The 3ADI+ platform will also support the private sector partners in the operationalization of the milk collection and feed distribution aspects of the PPP hub's functionality.

Two options for hub operationalization can be envisioned. In the first, the local government holds a tender, and received bids from private sector companies to be awarded with a long-term leasing agreement, granting the private company the rights to use of the hub infrastructure (structures and machines) for a designated amount (many years) of time. The company will operate the hub under conditions and scheme stipulated in the contract, including ranges for milk purchase prices, feed sale prices, and other aspects. The company would purchase milk from the VMCCs established within the context of 3ADI+ (and potentially others), and sells to a third party processing company or distributor. The contract would involve a stipulation on profit sharing with the local government owner and/or a distribution of dividends to farmers, as described in more detail below.

In the second option, the private sector company operating the hub could be one of the industrial dairies, an SME involved in dairy processing, or a start-up dairy processor. In this case, the milk purchased from the VMCCs would be used exclusively in the supply chain of that particular company. If this will be the case, joint planning will need to occur early in the project implementation, so that the company will be involved in the establishment of the VMCCs, as well as provide input on the design and construction of the PPP hub. In this case, the local government should still own the infrastructure and equipment of the hub, and the contract for operation should still include the stipulations involving milk and feed prices, and the profit sharing agreement.

The industrial dairy companies have their own expansion plans regarding the establishment of additional milk collection centers or company owned milk collection hubs. They have access to capital to finance the construction of the number of centers which matches the growth rate that they have projected for their businesses. While partnering with the lead firms in the dairy sector will enable the 3ADI+ intervention to reach scale rapidly, it is important not to make the lead firms the beneficiaries of the project.[64] The PPP mechanism allows for the funds

[64] In a project, recently concluded, of Land O'Lakes International Development, grant funds appear to have been given to the major industrial dairy companies (PRAN, BRAC and Akij), to construct milk collection centers and hubs. While such an

assigned for 3ADI+ implementation to be allocated to construct infrastructure which will be a public good, used to generate economic and social benefits for the population of small-scale farmers, under the ownership of the local government, and also providing a return to the local government. Following PPP best practice, in this scheme, the private sector partner takes all of the risk of operations of the business, and has the opportunity to capture the gains from its own profitable use of the infrastructure, which also enables inclusive economic benefits for farmers and the population as a whole.

Additionally, working in a partnership between local governments and private sector partners provides a model of dairy sector development which can be replicated, with each replication creating market outlets and earnings for thousands of farmers. The hub model of milk collection does exist in Bangladesh, as this collection scheme is operated by PRAN (while the other industrial dairies use different milk collection models). However, although the industrial diaries do provide embedded services to their suppliers, none of them have included the distribution of concentrate feed in those services. (Some have trained farmers in the cultivation of green fodder, which is now a widespread knowledge.) Additionally, with the exception of BMPUL, which is an initiative of the government and a government owned company, no PPPs are used in the milk collection segment of the diary value chain.[65]

Key infrastructure and technology investments

The following table provides the required investments for the construction and set-up of a PPP milk collection hub, at 231.6 million BDT, or 2.7 million USD. These figures show an economical scenario for site development and civil works, having the requisite strength and safety, and matching the site diagram and process flow chart presented earlier in the chapter. Another option, with standard quality materials would cost a total of 290.2 million BDT, or 3.5 million USD, due to upgrades to the site and civil works. Both options, as well as the detailed line items of construction, technology and equipment are included as Annex 2.

Table 36: Investments in infrastructure, technology and land for a PPP milk collection hub

CAPITAL INVESTMENT	Cost (USD)	Cost (BDT)
Land acquisition	431,125	36,214,500
Site development & civil works	830,013	69,721,114
Machineries procurement & setup		
Raw milk reception section	8,047	675,948
Vehicles	325,142	27,311,928
Processing, packaging & storage section	742,100	62,336,400
Quality control section	12,675	1,064,700
Office & retail store setup	18,231	1,531,404
Utilities procurement & setup	389,375	32,707,500
Total	**2,756,708**	**231,563,494**

approach may have some trickle down impact on farmers, these companies would have been likely to construct the collection centers even without the funds from Land O'Lakes. Therefore, the approach essentially made the lead firms the beneficiaries of the project, giving them millions of dollars for infrastructure construction.

[65] Other PPPs are visible in the diary sector, such as DLS allocating certain regions to the NGO BRAC to cover with AI services.

Business model for a PPP milk collection hub

The income statement and cash flow statement below show the basic operations of the private sector company operating the PPP hub infrastructure.

In terms of revenues, the sales of pasteurized and packaged milk are forecast at 10% of sales, pasteurized bulk milk, unpackaged, at 30% of sales, and unpasteurized bulk milk at 60% of sales. This is an extremely conservative forecast, assuming that the bulk of the milk is sold bulk to processors, with a small amount of packaged milk sold to a distributor who distributes in a nearby city. Increasing the percentage of milk sold pasteurized, and especially pasteurized and packaged, has a dramatic upward influence on revenues. The concentrate feed distributed to farmers is also booked as a sale for the purpose of correct accounting. The revenues also show rental of office space to an MFI, and usage of a classroom for training.

The largest expenses include the purchase of fresh milk from the VMCCs and the purchase of feed in wholesale amounts from a feed manufacturer. The purchase price of the milk is in alignment with the sale price of the VMCCs, of 43.5 BDT/liter, assuming a 39 BDT/liter producer price, 1.5 BDT/liter for transport cost from the VMCC to the Hub, 1 BDT/liter VMCC commission and 2 BDT/liter VMCC gross profit. The costs associated with the feed include a 24 BDT/Kg Ex Works factory price for feed, 1.5 BDT/Kg transport cost of the feed to the farmer associations, .5 BDT/Kg labor cost for feed manipulations, and a .5 BDT/Kg margin for feed system operation by the PPP hub.

The statements do not show depreciation, as the business model is for the operating company, which leases, but does not own the infrastructure. The depreciation would be included in the financial records of the local government. Payment of an interest expenses has also not been included, and would vary on a case by case basis depending on the funding requirements of the private sector operating company. However, the company would not be expected to have a high loan requirement, as it will not finance the construction of infrastructure, and milk collection and processing is generally supplier financed in Bangladesh.

The results show annual profits of 26.7 million BDT, equivalent to almost 320,000 USD, at a margin of just over 4%, which would be highly influenced by a variety of operational factors, such as the amount of milk sold packaged, prices of final products, and other variables, which have all been estimated conservatively in this model. As mentioned, the contract for operation could require a profit sharing arrangement, which is included at 50% of profit. In that case, the profit share to the local government and/or the farmers supplying milk would be 13.3 million BDT, or nearly 160,000 USD, with the operating company maintaining a 2% net margin.

Table 37: Annual financial results for PPP milk collection hub operating near capacity (30 tons/day), in BDT

INCOME STATEMENT		Annual
REVENUES		
	Milk - Pasteurized (Packaged)	105,464,700
	Milk - Pasteurized (Unpackaged)	177,867,000
	Milk - Unpasteurized	167,013,000
	Concentrate feed	208,926,000
	Rental income from MFI office	360,000
	Rental income from training center	60,000
Total revenues		**659,690,700**
EXPENSES		
COGS (Cost of Goods Sold)		
	Milk purchases (from VMCC)	381,352,500
	Packaging for pasteurized milk	3,256,200
	Concentrate feed purchases	189,216,000
Total COGS		**573,824,700**
Gross profit		**85,866,000**
Operational expenses		
	Collection and chilling overhead	18,090,000
	Pasteurizing overhead	10,854,000
	Distribution of packaged milk	5,427,000
	Transport of milk and feed to associations	11,826,000
	Labor/salaries for milk and feed operations	9,045,000
	Labor/salaries for feed operations	3,942,000
Total operational expenses		59,184,000
Depreciation on capital investment		
	Depreciation	0
Financing		
	Interest expense	0
Total expenses (operational, depreciation, interest)		59,184,000
PROFIT		
Profit		26,682,000
	Profit margin	4.04%
	Gross profit margin	13.02%
	Operational costs as % of revenue	8.97%
NET PROFIT		
	Profit share to city corporation or to farmers	13,341,000
Net profit		**13,341,000**
	Profit margin	2.02%
DIVIDEND		
	Distribution per cow	3,655
	Average dividend per farmer	5,483

CASH FLOW STATEMENT		Annual
Cash flow from operating		
	Profit	13,341,000
	Plus non-cash depreciation	0
	Less increase in working capital	0
	CFO	13,341,000
Cash flow from investing		
	Procurement of PP&E	0
Cash flow from financing		
	Issuance/repayment of loans	0
Cash flow		
Net cash flow		13,341,000
Cumulative cash flow		13,341,000

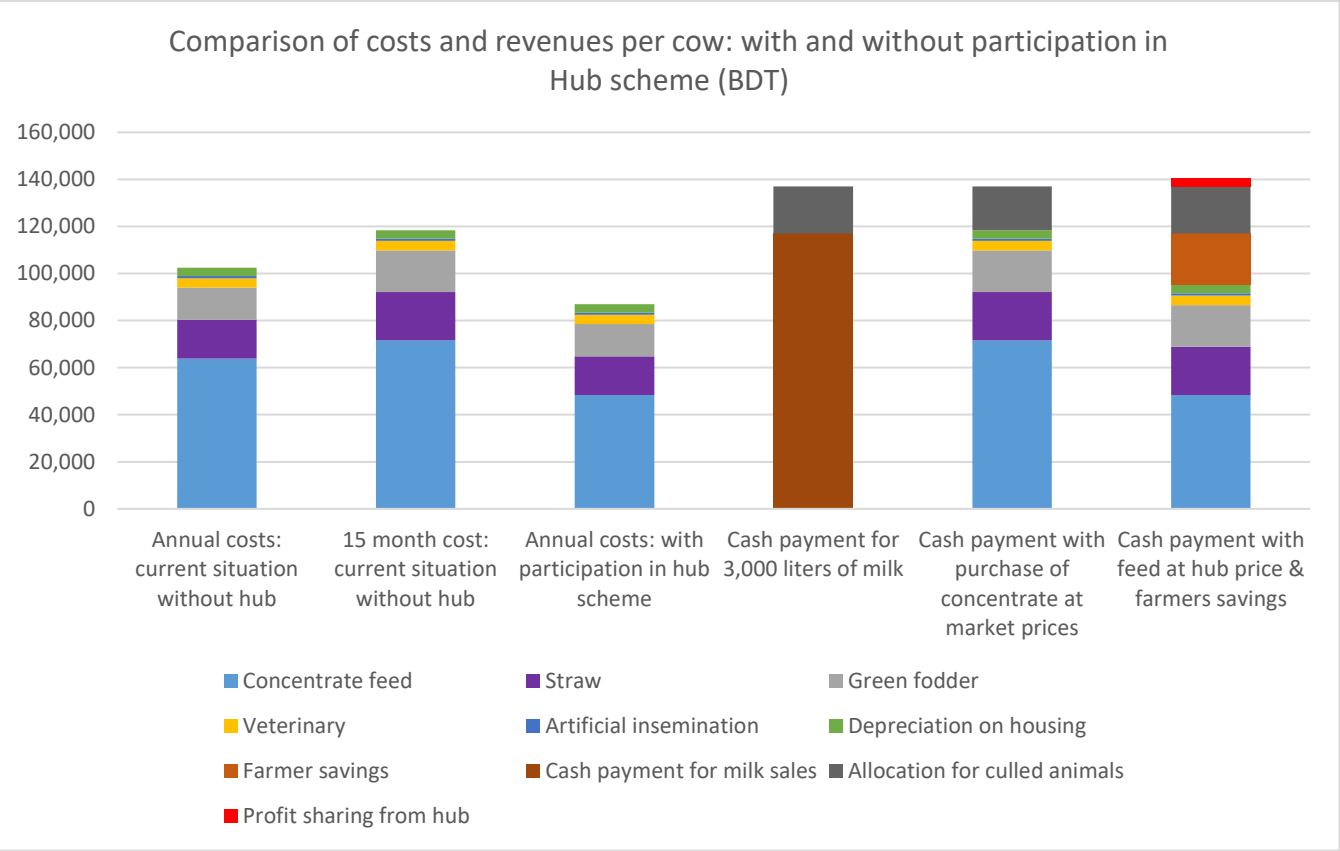
Impact of farmer participation in PPP hub feed-for-milk scheme on cow profitability

Participation in the PPP hub's market creation mechanism and the reduced cost of concentrate feed through the hub's feed-for-milk scheme, will make milk production a profitable business activity for farmers. The graph bellow shows the financial results of one lactation period for one cross-bred cow producing 10 liters of milk/day. The feeding regime, as well as veterinary and AI services hired, is adequate and conforms with requirements to support such a cow with a calf. The three columns on the left show the costs of rearing the cow and calf. The three columns on the right show different revenue scenarios, with the costs superimposed.

All of the national literature on livestock profitability uses one year as the period of analysis. As the graph shows, the costs reach 102,448 BDT. However, since the average calving period in Bangladesh is 15 months (as determined through field surveys of 100 farmers), the costs associated with one lactation cover a longer period, bring them to 118,383 BDT. However, with support from the 3ADI+ platform to reduce the calving interval to one year (as discussed in the business model section on primary production) and the reduced cost of concentrates through the feed-for-milk scheme, the costs are reduced to 86,975.

As shown in the fourth column, the revenues from milk sales for 3,000 liters at 39 BDT/liter come to 117,000 BDT, with an additional 20,000 BDT allocated from the culling of animals. The fifth column shows that the costs of rearing a cow in the current situation, with a new birth every 15 months, exceed the revenues from milk. As a result, farmers are forced to sell calves to make their livestock businesses profitable. This often requires the sale of heifers, preventing the farmer from expanding his/her herd, and using livestock as a path to wealth accumulation. The fifth column shows that in the context of 3ADI+ support, costs are lower than revenues from milk. This column also includes the dividend paid to the farmers for profit sharing in the PPP hub operations.

Figure 19: Comparison of costs and revenues per cow: with and without participation in the hub feed-for-milk scheme, in BDT



Alternative design functionalities of the PPP milk collection hubs

Depending on the local expected milk supply and regional market demand, different versions of the PPP hub can be envisioned. The hub described in the text and business model above has milk pasteurization and processing capability. Generally, milk processing factories which prepare primarily liquid milk products benefit from being located near the urban markets which they supply, as liquid milk requires daily deliveries. Milk processing factories producing solid milk products may be more easily located near the zone of milk production, as these products conserve longer and do not require daily deliveries. As noted, in the section above, the PPP hubs may increase the quantity of milk sold as a diary product (rather than as a bulk supply to other industrial dairies), if markets prefer. They type of products produced could also be altered based on the placement of the plant and the range of buyers.

By Bangladeshi standards, a small dairy plant is one processing below 10 MT of milk daily, and is only suitable for supplying small towns. A medium plant processes between 20 and 100 MT of milk daily, making the PPP hub suitable for transformation into a medium scale milk processing plant, depending on business planning during the implementation phase and options with private sector partners.

4.3.4 Traditional processors (business model 4)

Description of the intervention

As described in the section in the traditional processor segment of the core value chain analysis, most of these processors use production methods that yield a lower output of chhana than the best practices, potentially introduce unsafe ingredients into the products, and result in a lower quality product. Sources of these deficiencies include that the processors have technically appropriate method to test the quality of supplied milk, use

ingredients in optimized quantities, do not follow standardized or upgraded processing protocols, and may use substandard ingredients. These methods increase the waste in the process, decrease value, increase costs, and lead to lower profitability.

Through the capacity building of processors, based on technical training and introducing improved processing protocols, as well as the introduction of appropriate laboratory equipment and processing tools, both quality and value can be substantially increased, and the traditional products will be safer for consumption. In addition to upgrading their own processes, the traditional processes supported in the context of 3ADI+ will require a supply of quality milk, as the technical capacity building will train them to test milk provided by collectors, enabling the processors to protect themselves from purchasing diluted or otherwise adulterated milk. This action will in turn protect the traditional dairy sub-value chain from the value loss that is caused by adulterated and contaminated inputs. The traditional processors will experience a process upgrade, through the training and access to affordable technology, which will result in higher productivity, and a higher value and safer product.

Partnership and modality of implementation

With 50,000 to 60,600 traditional processors operating in the country, the intervention modality will need to operate through business service providers to deliver the process upgrade to as many traditional processors as possible. The 3ADI+ platform partners will develop an upgrading package, including a training curriculum for the innovated processing protocol, and including affordable laboratory and processing tools and equipment. Initially, in a pilot phase, the 3ADI+ partners will deliver the package to several traditional processors, to monitor and evaluate the results of the intervention. After perfecting the package, business models for training institutes will be designed, together with the curriculum and access to the necessary tools and equipment. Various 3ADI+ partners, as well as other universities, NGOs or other institutions, will host training institutes in the targeted territories around the country.[66] The training institutes are discussed in more detail in the next section.

Establishing wide accessibility to the upgrades as business development services offered through training institutes, operated by other independent institutions, enables the intervention to scale. Each institute will train, and potentially re-train, many traditional processors. Both the institutes and the training at the traditional processor level are replicable.

Key capacity building topics and technology upgrades

Traditional processors require upgrading at two levels of the process. First, the process of extracting chhana from milk will be improved, by ensuring a high quality supply of fresh milk, and upgrading processing methods. Second, the process of making the various traditional products (usually from the chhana) will also be upgraded. Some processors provide only the intermediate function of chhana extraction. Other processors undertake the process of extracting chhana and making products for end-user consumption, such as sweetmeats.

Process upgrades to chhana extraction: The following process upgrades are among those which processors using traditional methods will be supported to improve the chhana extraction process. As described, the various process upgrades either result in more chhana being extracted from one liter or milk, or the resulting chhana being of a higher quality and price.

1. The manufacture of good quality dairy products requires the use of good quality milk. As traditional processors do not test the milk which they purchase from collectors, the milk is often adulterated. They will be provided equipment and trained how to check the milk for fat, acidity and specific gravity. As a result, processors will be able to buy high quality milk containing more fat, total solids and normal acidity.

[66] Bangladesh Agricultural University has expressed interest in hosting the central training institute.

In the current situation, collectors supply milk to the traditional processors, and payment is made on the basis of volume, rather than on the basis of the fat or solids-non-fat (SNF) content of milk. Often, processors receive milk that is low in fat and SNF, with water added as an adulterant, and as a result, the yield of chhana (and ghee) decreases. As a result of the milk testing, processors will benefit in two ways, first, product quality will increase, and the market price will be higher; and, second, due to rejecting adulterated milk, they yield of chhana will be 15% to 20% higher.

2. While, traditional processors do not standardize the whey which is used to extract the chhana, in the improved method, the whey will be standardized to 1.0 to 1.5% acidity. The standardization of whey requires only one burette, one porcelain cup, a small amount of sodium hydroxide, and a phenolphthalein indicator to determine the acidity of the whey. Usually, the acidity of fresh whey is about 0.20% to 0.25% and after two to three days, the acidity increases beyond 1.5%. By mixing the fresh and old whey, the acidity will be adjusted to the desired level. Synthetic lactic acid and citric acid can also be used for to extract chhana. The lactic acid from the whey, and the synthetic lactic and citric acid are cheap and can be purchased easily. Therefore, the process improvement requires training, but the cost is very low.
3. Traditional manufacturers do not check the temperature of milk with a thermometer when adding the whey (lactic acid), which causes coagulation and chhana to form. At 75 to 80 degrees Celsius, the yield of chhana is the highest. Adding the whey at lower temperature decreases the yield by 10% to 15%. When prepared traditionally, one kilogram of milk yields about 150 to 160 gm of chhana, while in the improved method they yield can be 170-180 gm from one kilogram of milk.
4. While traditional processors generally do not use powdered milk, as using local milk is more cost effective for them. However, some imported, substandard quality powdered milk is very cheap and could even be hazardous for health. Some manufacturers have used this low quality cheaper powdered milk with liquid milk to reduce the production costs of chhana. However, this is a malpractice which is not allowed officially.
5. News reports have sited the use of other prohibited chemicals in dangerous doses, including preservatives such as formaldehyde.
6. Yield, shelf life and the quality of chhana will improve when using upgraded processes. While the market price of typical chhana is about 350 to 400 BDT/Kg, the market price of the better quality chhana reaches 500 BTD/kg. Market price is expected to increase by 25% to 30%.

Process upgrades for sweetmeat processing: While the processes for making various traditional products have been analyzed, the method of making improved rasogolla sweetmeats will be used as an example for the sector.[67]

1. As a result of the training on chhana extraction methods, sweetmeats will be made with higher quality chhana, which will increase sweetmeat quality and value.
2. Some flour is added to the chhana when making rasogolla sweets. However, since the current poor chhana extraction practices provide lower yields of chhana, processors make up for the lower quantities by adding more flour. Instead of the 3-5% of flour which is recommended, most processors use 10-15% flour per volume, with the chhana. As a result, the texture of rasogolla becomes harder and less swollen. To overcome this texture, the processors adding small amount of sodium bicarbonate (or baking powder) to the chhana. The addition of this chemical is not officially permitted. As a result of adding the additional flour, the output of rasogolla increases, even surpassing the amount when using the best practice with the increased chhana yield. However, when comparing the market prices of the improved and typical chhana, the improved method still yields higher revenues.

[67] In addition to rasogolla, other process upgrading analyses considered rasamalai sweetmeats, curd and ghee.

3. Rasogolla should be boiled in one concentration of sugar syrup, and then soaked in sugar syrup of a different concentration. However, traditional manufacturers do not prepare two types of sugar syrup. Additionally, they use this syrup for a long time, and as a result, degrade the quality of the final product.
4. Using the improved methods, the shelf life of rasogolla is extended.

Upstream and downstream impact on the traditional dairy sub-value chain

Supporting traditional processors to upgrade production practices will have impacts throughout the value chain. As the traditional processors require a higher quality milk input to improve their own products, they will test the quality of the milk supplied to them by collectors. Therefore, collectors will need to provide unadulterated, high fat and SNF content milk, or risk their supply of milk being rejected or assigned a lower price. In order to attain the highest prices, the collectors will influence farmers to provide them with higher quality milk. Farmers will be incentivized to better care for the animals, resulting in higher productivity and a higher fat content in the milk.

In the downstream value chain, higher quality and safer traditional products will be offered to the market at still affordable prices. The population will gain a consumer surplus (with the value of their food exceeding the price paid for it) as competition between the large number of fragmented processors, and low purchasing power, will prevent prices from escalating drastically with the higher value of production offered.

Thus, by working with the traditional processors, the 3ADI+ platform partners will be able to upgrade the quality and value of the entire traditional dairy sub-value chain. Since the traditional processors consume half of the milk produced in the country, interventions targeting them will have broader impact than interventions targeting any other value chain segment.

Financial results of milk production: traditional approaches compared to improved

While the ultimate goal of the intervention are the upstream impacts on farmers and the collection of quality milk, and the downstream impacts on food safety and quality, it is essential that the processors also benefit financially, so that the intervention is in their interest as well. Small changes to processing protocols and the use of non-complex laboratory tools and processing equipment, will provide significant financial gains to traditional processors. The cost benefit statements below show the impact of the improvements discussed above. Both statements are based on the processing of 40 liters of milk, which equates to the daily processing of a very small traditional processor, while larger processors (which have the same challenges in terms of quality and process) work with multiples of this amount of milk.

The first statement shows the results for an intermediate processor producing only chhana. The output of chhana from 40 liters of milk increases from 7 Kg in the typical process to 8 Kg in the upgraded process. (The actual increase in output will be from 6-7 Kg using traditional practices, to 7.5-8 Kg using improved practices.) Likewise, the price increases due to the far greater quality of the resulting chhana. Due to the low cost of the laboratory implements, the depreciation cost, on a daily basis, is insignificant. The increase in net profit to the professor is 798 BDT/batch, equivalent to 11 USD/batch. For the small processors, for whom the 40 liters represents their daily processing capacity, the difference leads to an increase of 291,150 BDT/year, or 3,988 USD/year – more than a doubling of annual income.

Table 38: Comparison of typical process and upgraded process for chhana processing

			Typical process			Upgraded process		
Revenues - sales of chhana								
	Quantity produced and sold	Kg			7			8
	Price	BDT			400			450
	Total revneues				**2,800**			**3,600**
Production cost		**Unit**	**Number**	**Unit cost (BDT)**	**Total cost (BTD)**	**Number**	**Unit cost (BDT)**	**Total cost (BTD)**
	Cost of 40 litre milk	Kg	40	45	1,800	40	45	1,800
	Cost of 5 kg wood (as fuel)	Kg	5	5	25	5	5	25
	Cost of labour and transport			Lump sum	200		Lump sum	200
	Electricity cost				40			40
	Packaging				50			50
	Depreciation cost				11.5			12.3
	Total				**2,125**			**2,127**
Profit								
	Total profit				**675**			**1,473**

Capital Investment								
	Refrigerator		1	35,000	35,000	1	35,000	35,000
	Processing implements (iron karai, spoon, balti, bowl, etc.)	Set	2	L S	7,000	2	Lump sum	7,000
	Laboratory implements (lactometer, lactometer cylinder, thermometer etc.)	Set	0			2	Lump sum	3,000
	Total		**Total**		**42,000**			**45,000**

Traditional processors producing sweetmeats from milk can also see significant benefits from using the improved processes. The traditional sweet rasagolla has been used as an example, which is representative of the other sweetmeats and traditional products made by processors. As they overuse flour, they produce 4-4.5 Kg of rasogolla from 1 Kg of chhana, while in the improved approach, processors obtain about 3.5 Kg of rasogolla from 1 Kg of chhana. Given a yield of 7 Kg of chhana in the typical method, the output of rasagola will be 31.5 Kg from 40 liters of milk, compared to 28 Kg in the improved method. However, the market price of traditionally processed rasagolla is about 150 to 180 BDT/Kg, while in the improved method prices reach 200 to 225 BDT/Kg. The chain sweetmeat shops in urban areas sell rasagolla for 400 to 500 BTD/Kg.

The resulting increase in price, with minor increases in production cost yields in increase in profit of 809 BTD/batch, or 10 USD/batch, even with the decrease in total rasagolla output. On an annual basis, small processors gain an income boost of over 40%.

Table 39: Comparison of typical process and upgraded process for rasagolla processing

			Typical process			Upgraded process		
Revenues - sales of rasagolla								
	Quantity produced and sold	Kg			31.5			28.0
	Price	BDT			180			225
	Total revneues				**5,670**			**6,300**
Production cost		**Unit**	**Number**	**Unit cost (BDT)**	**Total cost (BTD)**	**Number**	**Unit cost (BDT)**	**Total cost (BTD)**
	Purchase of whole milk	Kg	40	45	1,800	40	45	1,800
	Sugar	Kg	22	50	1,100	22	50	1,100
	Flour	Kg	3	40	120	1	40	40
	Wood/fuel for fire	Kg	50	5	250	50	5	250
	Electricity cost				40			40
	Labour and transport cost			Lump sum	300		Lump sum	300
	Cardamom			Lump sum	10		Lump sum	10
	Rent of facility			Lump sum	300		Lump sum	300
	Depreciation of invested capital				12.9			13.7
	Total cost of production				**3,933**			**3,854**
Profit								
	Total profit				**1,737**			**2,446**
Capital Investment								
	Refrigerator		1	40,000	40,000	1	40,000	40,000
	Processing implements (iron karai, spoon, balti, bowl, etc.)	Set	2	Lump sum	7,000	2	Lump sum	7,000
	Laboratory implements (lactometer, lactometer cylinder, thermometer etc.)	Set	0			2	Lump sum	3,000
	Total capital investment				**47,000**			**50,000**

<u>Business model for processor using typical processing methods compared to improved</u>

The table below compares the results of the two scenarios – typical and upgraded – for a mid-sized traditional processor producing sweetmeats, curd and ghee during the year. Processing quantities of milk vary between 150 and 300 liters/day, based on the demand patters for sweetmeats, curd and ghee during the year. Monthly sales volumes follow a similar curve.

Prices reflect field research, with the price for sweetmeats ranging from 180 BDT/Kg in the typical scenario, to 200 BDT/Kg in the improved scenario, which represents a conservative approach with more customer surplus, as the improved price could reach 225 BDT/Kg. Prices for the typical and improved scenarios for curd range from 120 BDT/Kg to 140 BDT/Kg, and for ghee from 850 BDT/Kg to 1,000 BDT/Kg, also both presenting a conservative approach.

Processing ratios are 78.8% and 70.0% for sweetmeats, 3.8% and 4.3% for ghee, and 92.5% and 90.5% for curd, in the typical and upgraded scenarios respectively – with the output increasing only for ghee. Differences between the two scenarios in the production of curd involves, among other techniques, the use of an incubator with uniform temperature and fermentation. In the case of ghee, using the electric cream separator, rather than a manual method, yields more cream, from which more ghee can be produced.[68]

[68] The model does not show the use of byproducts, such as preparing low fat chhana with the skim milk remaining after ghee production. Additionally, the model uses the production costs of rasagolla sweetmeats across all production, while an activity based costing model could be developed to more accurately allocate costs across the different products.

In both scenarios, the processes do not use milk powder, and according to the model, the milk available locally is sufficient for production during 11 months, with some chhana purchased as a processing input in November. The amounts of milk, sugar and flour follow the differences presented above. Neither scenario shows additional financing nor investment costs, as these models show ongoing operations, and not start-up or transitionary costs. The additional equipment for the upgraded scenario, is reflected in the depreciation.

The model simulates the same usage of fresh milk for both scenarios. However, the conservatively estimated premium pricing, due to the higher quality product, yields greater revenues, regardless of the overall slight decline in quantity of production. As a result, the already high margins of traditional diary product making increase, yielding higher incomes.

Table 40: Annual financial results for traditional processor – typical and upgraded scenarios, in BDT

INCOME STATEMENT		Typical	Upgraded
REVENUES			
	Sweetmeats	7,084,908	9,184,140
	Ghee	537,795	715,950
	Curd	1,848,150	2,097,900
Total revenues		**9,470,853**	**11,997,990**
EXPENSES			
COGS (Cost of Goods Sold)			
	Fresh milk	3,911,625	3,911,625
	Channa	68,906	78,750
	Milk powder	0	0
	Sugar	76,313	76,313
	Flour	8,325	2,775
Total COGS		**4,065,169**	**4,069,463**
Gross profit		**5,405,684**	**7,928,528**
Operational expenses			
	General overhead (less fuel)	41,625	41,625
	Fuel costs	124,875	124,875
	Packaging	0	0
	Distribution/transportation	0	0
	Labor/salaries cost	416,250	416,250
Total operational expenses		582,750	582,750
Depreciation on capital investment			
	Depreciation	20,962	30,800
Financing			
	Interest expense	0	0
Total expenses (operational, depreciation, interest)		603,712	613,550
PROFIT			
Profit		4,801,973	7,314,978
	Profit margin	50.70%	60.97%
	Gross profit margin	57.08%	66.08%
	Operational costs as % of revenue	6.15%	4.86%

CASH FLOW STATEMENT		Typical	Upgraded
Cash flow from operating			
	Profit	4,801,973	7,314,978
	Plus non-cash depreciation	20,962	30,800
	Less increase in working capital	0	0
	CFO	4,822,934	7,345,778
Cash flow from investing			
	Procurement of PP&E	0	0
Cash flow from financing			
	Issuance/repayment of loans	0	0
Cash flow			
Net cash flow		4,822,934	7,345,778
Cumulative cash flow		4,822,934	7,345,778

4.3.5 Traditional processor training institutes (business model 5)

Description of the intervention

Given the vast number of traditional processors across the country, numbering over 50,000, it will not be possible for the 3ADI+ platform to interact separately with a critical mass of them sufficient to incentivize the identified transformations in the traditional dairy sub-value chain. Therefore, in order to achieve scale, 3ADI+ will support other institutions to create training institutes, where traditional processors will attend short practical courses, to receive technical capacity building and have access to purchase the instruments and machines necessary to implement the technical upgrade. As envisioned in the business model below, one training institute would train 30 to 40 traditional processors per month, with fewer processors attending the course during the months of high demand for traditional products. The total number of processors trained per year would reach around 400 people.

Partnership and modality of implementation

3ADI+ stakeholder platform partners would develop the curriculum of the training institute based on the potential upgrades described in the traditional processor business model section, and other technical process improvements. These same partners could also establish a training institutes to deliver the training to the processors. Bangladesh Agricultural University or another university would be a prime candidate to host a central/demonstration training institute, with NGOs in the target territories of the project launching satellite institutes to train processors in their area of operations.

Business model for processor using typical processing methods compared to improved

The institutes will operate as social businesses.[69] As social businesses, after reaching scale, the institutes will cover their own operational costs through income generated by implementing their activities. This approach will support their continued operation beyond the conclusion of the 3ADI+ program in Bangladesh. The primary revenue sources to the institute include training fees, and the sale of laboratory equipment to students. The training fee for the month-long course is estimated at 10,000 BDT, or about 120 USD, which is only a fraction of the potential gain from using the improved processing methods, as shown in the last section. The laboratory equipment is

[69] The approach of social business (or social enterprise) is commonly found in Bangladesh and understood by partners. The phrase “social business” was coined by Mohammad Yunus. Further, many NGOs in Bangladesh, including BRAC and CARE, operate initiatives which they call social businesses.

estimated sold at bulk volumes with only a 10% margin added to cover institute costs. Other revenues will be generated by selling the high quality traditional products prepared at the institute during the classes.

The appropriate laboratory implements and the corresponding appropriate range of processing volumes by one traditional processor, are included in the table below. The table also shows the percentage of processors expected to purchase the different implements. The following table provides the financial results for one institute.

Table 41: Prices and appropriate usage of laboratory equipment offered to processors through the institutes

Item description	Appropriate processing range	Cost (USD)	Cost (BDT)	% of sales
Basic laboratory implements	< 500 liters/day	39	3,300	50%
Gerber fat test	500-5000 liters/day	262	22,000	25%
Hand held milk analyzer	500-5000 liters/day	440	36,960	20%
Milk analyzer	5,000 - 10,000 liters/day	1,760	147,840	5%
Digital milk analyzer	5,000 - 10,000 liters/day	4,583	385,000	0%

Table 42: Annual financial results for a traditional processor institute, in BDT

INCOME STATEMENT		Annual
REVENUES		
	Training fees	4,120,000
	Sale of laboratory equipment	9,036,808
	Sale of sweetmeats	1,648,000
	Sale of ghee	412,000
	Sale of curd	721,000
Total revenues		**15,937,808**
EXPENSES		
COGS (Cost of Goods Sold)		
	Laboratory equipment	8,215,280
	Fresh milk	1,957,000
	Milk powder	0
	Sugar	0
	Flour	0
Total COGS		**10,228,930**
Gross profit		**5,708,878**
Operational expenses		
	General overhead (less fuel)	20,600
	Fuel costs	61,800
	Packaging	0
	Distribution/transportation	0
	Labor/salaries cost (other)	206,000
	Instructor salaries	3,504,000
	Accommodation for students	824,000
	Outreach/marketing of training institute	285,444
Total operational expenses		**4,901,844**
Depreciation on capital investment		
	Depreciation	515,154
Financing		
	Interest expense	0
Total expenses (operational, depreciation, interest)		5,416,998
PROFIT		
Profit		291,880
	Profit margin	1.83%
	Gross profit margin	35.82%
	Operational costs as % of revenue	30.76%

CASH FLOW STATEMENT		Annual
Cash flow from operating		
	Profit	291,880
	Plus non-cash depreciation	515,154
	Less increase in working capital	0
	CFO	807,034
Cash flow from investing		
	Procurement of PP&E	0
Cash flow from financing		
	Issuance/repayment of loans	0
Cash flow		
Net cash flow		807,034
Cumulative cash flow		807,034

4.3.6 Slaughter facilities (business model 6)

Description of the intervention

As described in the meat value chain section, the condition of the slaughter facilities, or lack of facilities, prevents the preparation of safe, quality meat for the population. In major urban areas, only 20% of cattle are slaughtered in designated slaughterhouses, which are usually overseen by veterinarians employed by the city corporations. A larger proportion of cattle are slaughtered in the wet markets, with 40% of all cattle slaughtered in the capital, slaughtered in the market lanes in front of the butchers' retail stands in Dhaka, and with 30% in slaughtered in the markets other urban areas. The slaughtering of cattle in the wet markets is prohibited by law. The remaining cattle are slaughtered in make-shift locations, often on roadsides, before markets or stores, or in parks, yards, or other unsuitable places.

As noted, while Bangladesh has a Slaughter Act (2011), it lacks the subsequent legal guidelines to make the Act enforceable, as well as the human and financial resources to adequately monitor slaughtering. Particularly out of the major cities, the butchers and slaughters are not aware of any government requirement to slaughter animals in an officially designated facility.

When facilities do exist, in general, the design, condition of the infrastructure, and lack of any even rudimentary machines essentially eliminates any benefits (from the perspective of contamination of the meat and consumer safety) from using the official facilities. (Specific points of contamination, as well as bad practices which are unavoidable when using these slaughter facilities, and which lead to food safety issues and value loss for meat and hides, were described in the core value chain section of this report.) As noted, two slaughter facilities in Dhaka have recently been renovated. However, while the facilities include dramatic infrastructure improvements, they do not facilitate the improvement of the slaughtering practices with technology, or ensure that meat is not contaminated.

Since, as in developing countries across the world, the population prefers to purchase meat fresh in markets, no cultural shift away from the marketing of fresh meat (without refrigeration) can be expected. Likewise, the constructing of modern slaughterhouses with mechanized processes, providing specified cuts of meat, would also not be adapted either by the vast majority of butchers or consumers. Therefore, the key to providing safe meat to the population, and introducing technical process upgrades, will be to improve the slaughter locations, so that it is possible for slaughters and butchers to provide a product meeting basic standards to the population.

Therefore, as a first step to improving the slaughtering processes in the country, and to providing consumers with safe meat, the slaughter facilities will be upgraded with basic infrastructure and machines. Three upgrading models are proposed, corresponding to the five categories of slaughter locations described in the core value chain section of the report. Generally, the slaughter locations to be upgraded will be located in the urban areas, as the consumption of beef is higher in the cities, and because of the larger market sizes. The upgrading of the facilities will be accompanied by training to butchers in the use of the facilities.

While in most cases, facilities will be upgraded, the country also faces a shortage of slaughter facilities. In the estimation of the Bangladesh Meat Traders' Association, to provide the required meat to the city, Dhaka would require an additional 20 slaughter facilities, in addition to the current five larger facilities. Therefore, in several locations, new facilities could be constructed in the upgraded design.

Additionally, the butchers and slaughters which use the facilities, represent a fragmented private sector of a multitude of individuals (working with 1-3 family members or employees), which perform the slaughter where possible. Therefore, the upgrades will need to use machinery which is not only easily adoptable by this class of butchers, but the usage of which does not increase significantly the running costs of the facilities or the process of slaughtering.

Partnership and modality of implementation

Infrastructure and training upgrades, as well as training to build the capacity of slaughters and butchers, will be planned, implemented and monitored through the 3ADI+ platform. The platform will select the locations to be upgraded in the targeted territories, with a focus on the urban areas. An additional criterion for selection will be the proximity to cattle sourcing zones, and the facility to establish more direct trading relationships between livestock farmers and butchers.

Further, the upgrades will need to satisfy the interests of four key groups of stakeholders: the local governments, meat traders association and market the committees, the butchers and slaughters who are the users, and the consumers who purchase meat. The slaughter facility designs proposed by the 3ADI+ platform will be discussed in co-design groups, comprised of representatives of these groups, at the level of each slaughter house to be upgraded. The groups will analyze the proposed upgrades, expected changes to current practices, and financial implications, for each location, and agree on the improvement to be constructed. The upgrades will innovate and standardize the processes of slaughtering and butchering, and provide a safer product for consumers, with only minimal improvements to processes, costs and meat prices.

It will be critical to include the Bangladesh Meat Traders Association, as well as the meat traders' associations of different cities, and the local market committees in this collaborative planning and implementation process. The local governments (city corporations in the urban areas) own the slaughter facilities, and in several sites employ a veterinarian, a person who stamps the meat to certify that it is slaughtered at the given facility, and several other people. The government collects a slaughter tax. The facilities are operated by an enterprise or individual, often the meat traders' associations, who collet a fee (50-200 BDT/bull or cow, and less for smaller animals), oversee the process and pay utilities.

The infrastructure and technology upgrades will be implemented by the local government, with the 3ADI+ platform assisting in procurement in order to secure scale discounts from bulk orders of materials. The 3ADI+ platform partners, together with support from the collaborating groups, will develop the food safety training curriculum. The curriculum would be implemented, as determined by the platform, by DLS or the consortium of local governments, in collaboration with the meat traders associations. Certain slaughter facilities will be

designated as training facilities (in addition to serving their commercial purpose), where butchers and slaughters will receive capacity building.

The scalability of the initiative is based on its replicability, as well as delivery through a network of linked organizations, prioritizing private and public sector integration. The upgraded slaughter facilities, and the standardized and innovative processes used there, will also serve as models to be implemented in different areas of the country.

Key infrastructure and technology upgrades, and capacity building topics

The infrastructure and technology upgrades, as well as estimated costs, for the three different types of slaughter locations to be improved, are shown in the tables below. Costs for land and the basic structure of the slaughter facility are not included, as it is assumed that the local governments already own these elements.

The first upgrading model is for the midsized and larger facilities in urban areas, where 25 to 50 cattle (or more for religious festivals) are slaughtered daily. Key upgrades include the construction of a lairage facility, where cattle can be observed of at least one day before slaughter. The practices of lairage has been proven to reduce the incidence of disease in cattle, and enable observers to notice disease. Often cattle are weakened from travel to market on trucks of by hoof, and become ill if under stress and not rested. Pressurized water will also improve cleaning. While none of the facilities include a biogas plant or effluent treatment plan, these will be necessary to avoid environmental contamination. The facility would also have a carcass hoisting machine, so that the butchering of the carcass can occur with the carcass suspended in the air. This approach is much safer than the current practice of gutting and cutting the animal into sections on the ground, exposing it to the feces, stomach content, and blood of other animals – which carry contaminants.

A mini-diagnostic laboratory is foreseen for the larger slaughter facilities, to provide rapid tests of animal health, and the presence of diseases and contaminants. Currently, animals are only screened visually by a veterinarian employed by the local governments. Diagnostic tests performed the previous day could be used for a deeper screening of animals. Positive tests could be sent to the central disease control lab that DLS is constructing, or one of the several other central disease control labs in Dhaka.

An insulated or refrigerated truck is included in the cost of the upgrade, as the current method of transportation of meat by rickshaw is not safe and allows the introduction of many contaminants.

The total cost of the upgrade is 11.2 million BDT, or about 154,000 USD per facility.

Table 43: Investments in infrastructure and machines for slaughter facilities upgrade

CAPITAL INVESTMENT - FACILITY MODEL		Cost (USD)	Cost (BDT)	Number	Total cost (BDT)
Infrastructure					
Lairage facility for quarantine		7,000.00	511,000.00	1	511,000.00
Water pump and reserve tank to ensure water supply uninterruptedly		10,000.00	730,000.00	1	730,000.00
Net fencing to protect from wild birds & animals		6,000.00	438,000.00	1	438,000.00
Epoxy painting in floors and walls		5,000.00	365,000.00	1	365,000.00
Proper drainage facilities		6,000.00	438,000.00	1	438,000.00
Separate drain for collection of blood		6,000.00	438,000.00	1	438,000.00
Biogas plant and ETP		20,000.00	1,460,000.00	1	1,460,000.00
Generator/solar panel (for uninterrupted power supply)		10,000.00	730,000.00	1	730,000.00
Total					**5,110,000.00**
Establishment of mini diagnostic laboratory					
Microscope (2)		7,500.00	547,500.00	1	547,500.00
Autoclave		5,000.00	365,000.00	1	365,000.00
ELISA plate reader		12,000.00	876,000.00	1	876,000.00
Incubator		5,000.00	365,000.00	1	365,000.00
Centrifuge machine		5,000.00	365,000.00	1	365,000.00
Water bath		3,000.00	219,000.00	1	219,000.00
Laminar air flow		3,000.00	219,000.00	1	219,000.00
Distilled water plant		7,000.00	511,000.00	1	511,000.00
Total					**3,467,500.00**
Equipment					
Hoisting gear and railing for carcasses		7,500.00	547,500.00	1	547,500.00
Hide puller		5,000.00	365,000.00	1	365,000.00
Total					**912,500.00**
Transportation of meat					
Chilling van to transport carcasses to selling points		24,000.00	1,752,000.00	1	1,752,000.00
Land and structure					
Construction		0.00	0.00	1	0.00
Land		0.00	0.00	1	0.00
Total					**0.00**
Totals					**11,242,000.00**

As a large proportion of the cattle slaughtered in the country are killed in wet markets, an upgrading model appropriate to these locations is proposed. While the majority of cattle are slaughtered in the wet markets, fewer are slaughtered in a single market than in the officially designated slaughter houses. As a result, the investment per market slaughtering area is smaller. The total investment is 1.7 million BDT, or about 24,000 USD. The recommended infrastructure upgrades and equipment are shown below.

Table 44: Investments in infrastructure and machines for upgrade of market slaughtering areas

CAPITAL INVESTMENT - MARKET MODEL		Cost (USD)	Cost (BDT)	Number	Total cost (BDT)
Infrastructure					
Lairage facility for quarantine		6,000.00	438,000.00	1	438,000.00
Water pump and reserve tank to ensure water supply uninterruptedly		10,000.00	730,000.00	1	730,000.00
Total					**1,168,000.00**
Equipment					
Hoisting gear for carcasses		3,000.00	219,000.00	1	219,000.00
Hide puller		5,000.00	365,000.00	1	365,000.00
Total					**584,000.00**
Land and structures					
Construction		0.00	0.00	1	0.00
Land		0.00	0.00	1	0.00
Total					**0.00**
Totals					**1,752,000.00**

Finally, some of the roadside sites could be transformed into slaughter facilities, in cases when the usage per day would be sufficient to justify the investment. The recommended infrastructure and machine are shown blow, with a total investment cost of 927,100 BDT, or about 12,700 USD.

Table 45: Investments in infrastructure and machines for upgrade of roadside slaughtering areas

CAPITAL INVESTMENT - ROADSIDE MODEL		Cost (US$)	Cost (Tk)	Number	Total cost (BDT)
Infrastructure					
Slaughter slab		6,000.00	438,000.00	1	438,000.00
Adequate drainage facilities		2,500.00	182,500.00	1	182,500.00
Submersible water pump		1,200.00	87,600.00	1	87,600.00
Total					**708,100.00**
Equipment					
Hoisting gear for carcasses		3,000.00	219,000.00	1	219,000.00
Total					**219,000.00**
Land and structures					
Construction		0.00	0.00	1	0.00
Land		0.00	0.00	1	0.00
Total					**0.00**
Totals					**927,100.00**

Integrated business models for slaughter facility stakeholders: current and upgraded scenarios

The tables below show the results of the technological and process upgrades on the operations of the key stakeholder groups: the enterprise or association that manages the slaughter facility, the local government that owns and superverses the facility, and the butcher. The impact on consumers is reflected in an increase in the price of meat, for a safer and higher quality product. For each of these groups, different scenarios are shown, simulating the models for the slaughter facilities, market slaughtering, and roadside slaughtering. Financial statements (income statements and cash flow statements) showing on year of operations by month for each scenario and each stakeholder group are included in Annex 1. The information below presents a summary on an annual basis.

The first statement shows the results for the association managing the slaughter facility. In the official slaughter facilities, butchers pay a fee to have their cattle slaughtered, ranging from 50-200 BDT/cattle. The fee is 50 BDT/cattle in most slaughter facilities in Dhaka. The statements below, for the management association shows revenues of 552,500 for the collection of a 50 BDT/cattle fee, for an average number of 35 cattle slaughtered per day, distributed seasonally throughout the year. No sales of blood are shown in the statements. Currently, the infrastructure does not allow for the collection of blood, and all of the blood is waste. The upgraded facility will have separate blood collection, and the blood could be collected from all of the animals and sold by the management association. No revenues have been forecast from the sale of blood as additional study of markets and buyers is necessary to confirm the feasibility of such revenue.[70] The costs of operating the facility are shown, including that the association pays 50% of its collection of slaughter fees to the local government.

In the case of the slaughter facility, the 50 BDT/animal is increased to 150 BDT/animal. The number of cattle is estimated to increase by 50%. In the planning of the city corporations, the slaughter facilities should slaughter cattle, with the meat being distributed to the different wet markets. In practice, little meat is distributed as there is no formal system of distribution, and butchers have resorted to slaughtering for themselves in the different markets of the city. In order to enable the distribution of meat and realize the system envisioned by the city corporations, a vehicle for distribution has been included in the investment costs of each slaughter facility being upgraded. The vehicle could be managed by the associations, who would plan its distribution route and quantities in collaboration with butchers in surrounding markets. This distribution would be managed as a separate business unit, the revenues and cost of which are not included in the model below. Assuring the distribution of beef from the slaughter facilities to the surrounding markets, as well as the improved ease of slaughtering and product quality at the upgraded markets, underlies the estimated 50% increase in usage.

The statements also show the income statement projections for the management associations in the market and roadside slaughtering areas. Since these areas are not currently formally used as slaughter houses, they are not managed as such. The slaughtering fee is set at 150 BTD/animal as with the existing slaughter facilities. Fourteen cattle per day are projected to be slaughtered for each of these locations.

Overall, the upgrades provide beneficial financial results for the three models.

[70] Bangladesh imports a significant amount of meat and bone meal (MBM) for use in production of animal feed. Global Capsule, the leading Bangladeshi company making gelatin from bones, does (or has) sold MBM and blood meal to the national feed companies. However, the supply of MBM and blood meal is far insufficient to satisfy the feed companies' demand. Reportedly, Bengal Meat, the vertically integrated company operating the only modern slaughter house in the country has supplied blood for the purpose of blood meal preparation, although the business line was discontinued.

Table 46: Income statement for slaughter facility management association: results of upgrading different facility types

INCOME STATEMENT - MANAGEMENT OF FACILITY		Base case - slaughter facility	Slaughter facility upgraded	Market upgraded	Roadside location upgraded
REVENUES					
	Slaughtering fee	552,500	2,486,250	663,000	663,000
	Sales of blood	0	0	0	0
Total revenues		**552,500**	**2,486,250**	**663,000**	**663,000**
EXPENSES					
	Overhead (water, electricity, garbage)	5,525	16,575	5,525	5,525
	Labor/salaries cost	131,400	131,400	131,400	131,400
	Share to city corporation of fee collected	276,250	1,243,125	331,500	331,500
	Depreciation	0	0	0	0
	Interest expense	0	0	0	0
Total expenses (operational, depreciation, interest)		413,175	1,391,100	468,425	468,425
PROFIT					
Profit		139,325	1,095,150	194,575	194,575
	Profit margin	25.22%	44.05%	29.35%	29.35%

In addition to the management associations, the local governments will be concerned with the impact of the upgrade on their finances and operations. The revenues for each of these slaughter locations is made up of the slaughter tax paid by the butchers, and half of the slaughter fees collected by the associations – of 50 BDT/animal in the slaughter facility base case, and 150 BDT/animal in each of the other scenarios. The local governments also have employees working at the facilities. A lab technician to operate the mini-diagnostic lab is foreseen only for the upgraded larger slaughter facilities, as the number of cattle slaughtered in the other scenarios does not initially justify the investment. All of the depreciation for the upgrades of infrastructure and equipment is carried by the local government, as it is the owner of the facilities. Each of the upgrading scenarios are shown to deliver income to the government.

Table 47: Income statement for local government: results of upgrading different facility types

INCOME STATEMENT - LOCAL GOVERNMENT		Base case - slaughter facility	Slaughter facility upgraded	Market upgraded	Roadside location upgraded
REVENUES					
	Slaughter tax	1,105,000	1,657,500	442,000	442,000
	Payment from facility management committee	276,250	1,243,125	331,500	331,500
Total revenues		**1,381,250**	**2,900,625**	**773,500**	**773,500**
EXPENSES					
Operational expenses					
	Employees 1-5 (veterinarian, etc.)	1,007,400.00	1,007,400.00	613,200.00	613,200.00
	Employee 6 - lab tech/operator	0.00	350,400.00	0.00	0.00
	Depreciation	0	868,700	87,600	46,355
	Interest expense	0	0	0	0
Total expenses (operational, depreciation, interest)		1,007,400	2,226,500	700,800	659,555
PROFIT					
Profit		373,850	674,125	72,700	113,945
	Profit margin	27.07%	23.24%	9.40%	14.73%

In the scenarios discussed above, the slaughtering fee increases – by 100 BDT/animal in the case of the larger-scale slaughtering facility, and from 0 BTD/animal to 150 BDT/animal in the other two cases. Therefore, securing the agreement of the butchers prior to implementation will be critical. The statements below show the annual results of a butcher in each model, who typically slaughters one animal per day. Due to the higher quality and safer meat which the butcher will sell, prices for "meat with bone" are estimated to increase by 5%. This increase more than covers the added costs, with the butchers becoming more profitable in each model with the upgrade than in the non-upgraded scenario. The marketing campaign and food safety traceability certification would be targeted in part on the customers of the butchers, and would support the 5% increase in price. The price increase is from 450 BDT/Kg of beat to 473 BDT/Kg, which is entirely plausible, as in some areas of the capital meat sells for 500 BDT/Kg.

These estimations do not include the potential revenues from selling the blood. A system could be established wherein the butchers sell the blood to the management association in place of paying the slaughter fee, and the association sells the blood in a batch. The butchers would also educate consumers themselves by describing the improved practices, to gain customer and to become more competitive than other butchers using facilities not equipped for fully sanitary slaughtering. The cost of the blood would easily eliminate the need to pay the slaughter fee.

Table 48: Income statement for butcher: results of upgrading different facility types

INCOME STATEMENT - BUTCHER	Base case - slaughter facility	Slaughter facility upgraded	Base case - market	Market upgraded	Base case - roadside	Roadside location upgraded
REVENUES						
Meat with bone	13,513,500	14,189,175	13,513,500	14,189,175	13,513,500	14,189,175
Offal (including stomach)	955,500	955,500	955,500	955,500	955,500	955,500
Hide (under current conditions of tanneries)	81,900	81,900	81,900	81,900	81,900	81,900
Bone waste	27,300	27,300	27,300	27,300	27,300	27,300
Blood waste	0	0	0	0	0	0
Total revenues	**14,578,200**	**15,253,875**	**14,578,200**	**15,253,875**	**14,578,200**	**15,253,875**
EXPENSES						
COGS (Cost of Goods Sold)						
Cows or bulls	12,285,000	12,285,000	12,285,000	12,285,000	12,285,000	12,285,000
Total COGS	**12,285,000**	**12,285,000**	**12,285,000**	**12,285,000**	**12,285,000**	**12,285,000**
Gross profit	**2,293,200**	**2,968,875**	**2,293,200**	**2,968,875**	**2,293,200**	**2,968,875**
Operational expenses						
Fee per cow/bull - to facility/committee	13,650	40,950	0	40,950	0	40,950
Slaughter tax - to government	27,300	27,300	0	27,300	0	27,300
Rent of market stall	360,000	360,000	360,000	360,000	360,000	360,000
Transport of cattle	27,300	27,300	27,300	27,300	27,300	27,300
Labor/salaries	136,500	136,500	136,500	136,500	136,500	136,500
Depreciation	352	352	352	352	352	352
Interest expense	0	0	0	0	0	0
Total expenses (operational, depreciation, interest)	**565,102**	**592,402**	**524,152**	**592,402**	**524,152**	**592,402**
PROFIT						
Profit	1,724,230	2,372,605	1,769,048	2,372,605	1,769,048	2,372,605
Profit margin	11.83%	15.55%	12.13%	15.55%	12.13%	15.55%

4.4 Core system interventions

The three system interventions described below accompany the value chain based business models, and reinforce the coordinated upgrading of the chain by promoting transformations in the operating environment. These transformations reinforce and incentivize the value chain actors to use the improved processes and new capabilities delivered to them through the stakeholder platform's work in the core value chain segments.

4.4.1 Creation of industry trade associations (systemic intervention 1)

Description of the intervention

As noted in the governance section, no overarching trade associations exist within several of the value chain segments. The lack of these horizontal linkages disadvantages the actors in these segments, as they lack the ability to voice a unified opinion on legislation and regulation and the use of public resources, and they have no mechanism for knowledge sharing, networking, price negotiation, or taking advantage of economies of scale through joint sector or geographically united activities.

Support will focus on the milk collectors and traditional processors, who lack any business association. Additionally, although the processors which supply to the industrial dairies are organized, including as cooperatives in the Bangladesh Milk Producers Cooperative Union Ltd, there is no association of producers that exists separately from this processing company. There exist national and local associations of meat traders, as well as market committees, although the local associations require capacity building. Although there is no association of cattle traders, the traders reportedly operate in a collaborative fashion, including exhibiting some mafia-like tendencies.

Organizing these fragmented segments of the value chain will also increase accessibility and responsiveness of the actors in these segments to receiving external support (from DLS and other service providers). By providing representation though elected officers, the associations will enable more efficient communication and relations on a national and local level.

Once formed, the members of the associations will be educated on how to monitor and influence legislation and regulation, and to influence the political process, both nationally and locally. The associations will receive capacity building on the creation of business networks, the exchange of information about prices and best practices, about business opportunities, about accessing knowledge and technology, and about taking advantage of economies of scale when focused on common objectives.

The intervention will upgrade the organization in the value chain, make the actors more accessible, and provide the actors with a mechanism to advocate for policy change. The 3ADI+ platform partners will support the new associations to become dynamic and self-expanding, in order to increase their voice, influence, and the benefits gained by members.

Partnership and modality of implementation

The producer associations and other industry trade associations (collectors, traditional processor, and others to receive capacity building) will be created initially in the territories where the project is focused. The producer associations in particular, will become the primary channel of communication between the 3ADI+ stakeholder platform and the actors. The associations will be formed by the 3ADI+ platform member responsible for interventions in the specific value chain segment, who may subcontract the activity. The creation of industry trade associations is not included as a separate project component, but activities with this focus are included as an activity within the interventions targeting the producer, collector and traditional processor value chain segments.

4.4.2 Food safety certification for traceability (systemic intervention 2)

Description of the intervention

People scared by these incidents, and particularly from epidemics of zoonotic diseases, but uneducated about what makes food safe. Bangladesh has a Food Safety Act (2013), and is in the process of developing rules and guidelines to implement the law. There are a few food safety laboratories in Dhaka, but not available in other parts of the country, therefore the products cannot be certificated. No agri-food traceability law, in any sector, as under the current conditions it would be impossible to enforce, and costly to establish the traceability systems on a national, or even regional scale.

BFSA small and food safety system has shallow reach; still, finds E.coli and other issues in the output of the industrial dairies (large companies and the newer SMEs); as a result, companies are shut down for a time, make some upgrades, and open until another issue is found. No company has proved immune to food safety problems, creating a lack of trust in the industry, particularly for the private sector companies, which have less trust than the government company BMPCUL; this works through enforcement and shutting down companies with food safety issues for a time

Problem could be with milk that comes into the company, many cows have an unnoticed low level of mastitis, could be contamination in transport, also transport to Dhaka factory, processes in factory usually good, distribution can be a problem when not a completely proprietary system of the processor

3ADI+ interventions in the sector provide an opportunity to initiate the establishment of a voluntary food safety certification. It will be linked with traceability system that would go further in guaranteeing food safety than current methods. Link a food safety certification with the traceability system, so that actors in each value chain segment can be trained and certified as complying with the basic standards required in Bangladesh, as well as being able to trace the raw materials and food products through the different certified actors. This way, the certification will relate not only to the internal processes of that particular actor, but also to all of their suppliers and buyers, certifying all of the vertical linkages. Each certification will verify that that actor, and all proceeding actors who came into contact with the raw materials, other ingredients, and the product, comply with food safety standards.

It will have a logo which will be promoted in the educational marketing campaign, and the certification at each level will be linked to courses provided as part of the 3ADI+ platform interventions, including through the training institutes to be established. The institute for traditional processors is one of the institutes to be established, and attending the training will be necessary in order to receive the certification.

It will be established as a voluntary system as a model for operations, which could later be expanded in the value chain, or replicated for other value chains. Establish this as a positive reinforcement, with a certification that is linked with the educational marketing campaign, the support to livestock farmer associations, the collector association (and the collectors supported to use the best technology and practices), the traditional processor association and the processors who have completed the training course at the institutes, the hubs, and the upgraded slaughter facilities. Would be too costly to build a fully functioning traceability system, as there are too many points where complete control and transparency cannot be assured. Several characteristics of food production processes in Bangladesh, in the industrial and traditional sectors, make constructing traceability systems less efficient, including the low reliability of information, the lack of fluid communication, or established mechanisms of transactions between many actors, lack of standardization and product uniformity.

However, can initiate the structure, which will provide a model to be improved, as well as make huge progress in making dairy and meat products safer for the population.

In general traceability system requires: the ability to track all food materials through the stages of production, aggregation, processing, distribution and retail sales. This includes tracking upstream, and traceability downstream. At the level of every actor, need to be able to establish traceability one step backward in the supply chain, and one step forward in the chain, as well as the internal traceability of the actor's own process. Traceability focuses on raw materials, and any additives to products, and correct packaging, including that packaging accurately represents the contents of the package.

The 3ADI+ platform activities in the dairy value chain will be more complete, and reach across the different segments, enabling platform members to interact with actors in nearly every value chain segments. This close interaction will facilitate launching the certification and traceability procedures in the territory where the project is being implemented, with the selected beneficiary farmers, entrepreneurs and companies.

Primary producers: The certification organization, in partnership with the 3ADI+ platform partner focused on primary producers, will provide training on food safety control measures to farmers, as well as undertaking periodic monitoring of their food safety practices. Farmers will gain knowledge and skills on herd management related to food safety and hygiene. Food safety control measures will aim to manage hazards arising from inputs such as AI, medicines and feed; the design, construction, maintenance and operation of sheds and living conditions for cows; and the hygiene and conditions of milking cows, people involved in milking, and milking practices. Special attention will be given to the health of animals, and ensuring that the environment is sanitary and clean. Training will also touch on the temperature and other conditions for conserving milk. In order to create a traceability

system, the animals in the associations supported by 3ADI+ will be identified, including their breeds and other information, with the information recorded in an identification system at the level of the farmer and association. Creating such an animal identification system, with the associations receiving support from 3ADI+, will be essentially the first attempt to create an animal identification system in the country, and will provide a model for further replication and scaling up. In their farm records, as discussed in the section on upgrading primary production, farmers will maintain a track of the inputs purchased or received for their cattle.

Entrepreneur collectors and the PPP milk collection hubs: The training and monitoring provided to collectors will be delivered through the 3ADI+ stakeholder platform, to the collectors and hub operators supported by the project, and also to a wider selection of collectors engaged through the collector business associations. Training will focus on those collectors linked to and buying from the producers supported by 3ADI+, which will facilitate monitoring and establishing traceability. Food safety capacity building will focus on control measures to manage hazards arising from the surfaces of equipment and containers used to collect and transport milk, including vehicles or carts, the conditions of milk transport such as timing and temperature, and the people engaged in the dairy transport business. Collectors performing milking themselves will also receive training on and the hygiene and conditions of milking cows, and milking practices. Controls/regulations on time and temperature. Most collectors keep records of suppliers and buyers of their milk, including volumes delivered, for purposes of payment, and these records may need to be upgraded for the purpose of traceability.

Traditional and industrial processors: Generally, food safety and traceability training and monitoring will be focused on the traditional processors and SME industrial processors supported by the 3ADI+ platform. Skills and knowledge on food safety and processing protocols and methods to produce safe dairy products will be delivered through the trainings at the traditional processor institutes, as well as the technical support on equipment usage and product development provided to SME industrial processors. Trainings at the institutes will also focus on regulations about which ingredients and additives can be used and in what quantities/concentrations to maintain safety. The institute courses and the other support elements constitute the required training in order to receive the initial certification. It will be important that processors do not use any milk coming from a diseased animal, and that diseased animals be isolated from the milk producing herd. This traceability requirement will be made possible through 3ADI+ engagement and monitoring of the primary producers, with each animal having an identification number. As traditional processors sell from their own storefronts/restaurants, they will be able to display the logo of the certification on their premises. Industrial processors will be able to use the logo on packaging. The monitoring organization will also analyze the distribution channel, cooling methods, cold chain, and length of time to sale.

Beef value chain: Traceability will be more difficult to establish in the beef value chain. For producer, the same approach will be taken as in the diary value chain, and indeed many of the producers will be the same individuals or members of the same associations. The 3ADI+ platform will also be upgrading the slaughter facilities to ensure basic levels of food safety, and provide training and monitoring on procedures there to meet food safety standards. The cattle trading function poses the challenge for traceability, which occurs in a decentralized system, in which one cow or bull may be traded up to four times before being purchased by the butcher. As noted in the section on producers, the 3ADI+ platform partners will investigate possibilities to link producers directly with butchers, possibly by working through a single agreed trader.

While too many uncontrollable elements exist in these partially informal value chains to guarantee full compliance with food safety standards, and full traceability, the targeted actors will be able to greatly improve their processes, the safety of their food, and value of their outputs, aiming to add a premium to their prices. Additionally, due to the traceability, negative health impacts on the population will be minimized by tracing the source of the

contamination. As the traceability system will be monitored, identifying the incident, isolating it, understanding the source of the contamination, and eliminating the source will be facilitated.

The establishment of the food safety certification, and the linked traceability system, will reinforce the upgrading of processes in the value chain, with the objective of increasing the quality and value of products. The certification and its accompanying logo will be a visual indicator, useful particularly for consumers, that the processor, and all of the upstream suppliers have upgraded processes and procedures to meet hygienic and food safe standard practices. The certification will provide a visual symbol of higher value, which could also justify higher prices. The monitoring and certification process enables the 3ADI+ platform partners to verify that value chain actors have transformed their practices. This form of verification will continue indefinitely in the future, with the inspections and monitoring undertaken by the certification social business housed, most likely, at the BFSA. It also serves as an incentive to value chain members to maintain the better practices learned within the context of the 3ADI+ initiative. Scalability of the upgraded practices is achieved by working through existing government institutions as the service provider, and establishing a model which can be institutionalized and expanded to an increasing number of farmers, and even value chains.

Partnership and modality of implementation

The operations of the voluntary certification of food safety and traceability system will be housed in a currently operating entity in Bangladesh overseeing food safety in the dairy and meat value chains, with the Bangladesh Food Safety Authority (BFSA) being the most suitable organization. Companies and individuals wishing to be certified will pay for the training courses and certification, and re-certified annually, at a cost which is less than the premium in prices they are able to charge, because of having the certification. Producer can possible charge higher prices for their milk, as they will have a guarantee of the health of the cows and people involved. Given the income from the courses and certification process, the proposed certification agency can operate as a social business unit, while housed within a Bangladeshi food safety authority.

The 3ADI+ platform will monitor the implementation of the system. An initial budget will be provided through the platform, however, as the social enterprise will for charge the inspections, evaluations and coaching required to receive the certification, the unit will eventually operate sustainably. The costs of introducing the food security and traceability system include the development of the operational plan and monitoring, inspection and audit procedures, the cost of maintaining accurate records. Set up costs for the system itself include costs for drafting the fundamental plan and procedures necessary to establish the traceability system electronic information systems and software development, and the costs of education and training. Ongoing operational costs include labor costs for product identification and recording information, possibly an electronic information system for tracking, and inspection and auditing.[71]

4.4.3 Educational marketing campaign (systemic intervention 3)

Description of the intervention

As a result of the high incidence of zoonotic diseases, including recent outbreaks of the H1N1 “Bird Flu” which created a scare in the population, and the prevalence of such diseases as anthrax and brucellosis, the population values safe food. “Safe food” is a common phrase used by both producers and consumers alike. Additionally, the

[71] While not included here, a business model for the certification organization, operating as a social business within a larger food safety authority, could be developed. The revenues would be the fees that processors and other actors pay to be certified, which would be far less than the additional revenues which they will gain from the premium prices they charge with the visible logo, certifying that they have improved, more hygienic, and safer processes and products.

fear of consuming diseased meat underlies the cultural preference for purchasing fresh meat in wet markets. Consumers demand to see chickens killed and dressed before their eyes – as a guard against butchers selling the meat of sick birds. The same is true for bovine and goat meat, to the extent possible. Buyers arrive in markets very early in the morning, often while the animals are being slaughtered.

Regardless of this high alert and level of concern, the vast majority of people are not able to describe what makes food safe. In consumer surveys implemented within the context of 3ADI+, nearly all respondents listed quality and safety as one of their primary criteria when selecting which food products to buy, but they could not define what makes a dairy or meat product safe. As a result of this lack of knowledge, consumers often confound which food actually is safe. For example, antibiotic residues are rife in the poultry in Bangladesh and not uncommon in meat. While increasing antimicrobial resistance, from the overuse of antibiotics, will not lead to an immediate illness, the effects are highly dangerous. However, even witnessing the slaughter of the animal in the market would not protect a consumer from consuming meat with antibiotic residues.

This lack of education on the part of the population renders people incapable of protecting themselves and their families from unsafe food. Further, uninformed people are unable to demand that actors in the agro-food sector follow safe production and processing practices, maintain good hygiene, and use only approved raw materials. The lack of knowledge on the part of the population disempowers consumer pressure, and undermines the potential of market demand to influence value chain actors. As a result, value chains delivering food to domestic consumers do not develop in quality or value.

As mentioned in the section on standards and norms, among the most important characteristics that Bangladeshi consumers are looking for when making a purchase decision about a food product are safety and quality. In consumer surveys conducted by 3ADI+, although nearly every customer ranked safety and quality highly as important product characteristics, they could also not describe what makes a product safe. Their lack of knowledge disempowers consumers before the processors and suppliers of food products. Since consumers are uneducated about the potential harms form contaminated food, the kinds of contamination, and the sources of contamination, they are unable to promote the safety of themselves and their families.

In order to build the knowledge of consumers, empower them to demand safer products, and increase market demand for safe and quality products, the 3ADI+ platform partners will implement a social market campaign using social media and traditional advertising channels. The objective will be to educate consumers so that they can use real criteria for food safety to protect themselves. Consumers will prefer to purchase from producers, processors and vendors who have improved their practices to ensure the production of safe food.

Whereas the food safety and traceability certification will inform consumers that a particular product is not contaminated, the social marketing campaign to educate consumers about what makes a dairy or meat product safe. The certification logo will feature in the social marketing campaigns, and become a tool which consumers can use to recognize products that have been certified as safe. This creation of demand for safe food, focused on the certification logo, will increase the value of the certification to processors and other value impact of early marriage, dowry, smoking chain participants, and reinforce their use of good practices in hygiene and food safety. Ultimately the social marketing campaign will resolve issues around consumer lack of trust for dairy and meat products, and channel revitalized demand to the certified products.

Social marketing is frequently in Bangladesh, with examples including Meena, a children's educational program produced by UNICEF; mobile SMS communications related to agriculture, and maternal and child health; events such as street theater organized around topics such as nutrition and exclusive breast feeding; and posters and comic books on the topics of early marriage, dowries and to discouraging smoking.

The end result of the campaign will be to build and reinforce demand for quality products in the value chain. Educated consumers will be able to use the power of the market to demand higher quality and safer foods. Consumers will seek safer foods, and ask that processors and butchers use improved and more hygienic methods. Ultimately, the increase in consumer knowledge will initiate a shift in the market system structure, enabling consumers to demand a high quality, higher value food, rather than being satisfied with undifferentiated, unsafe and low quality food products.

Partnership and modality of implementation

The 3ADI+ platform will subcontract the design and implementation of the educational marketing campaign to a Bangladeshi PR/advertising firm, to translate the objectives of the campaign into clear and simple messaging around food safety. 3ADI+ will also define indicators to measure results, such as an increase in sales of products certified as safe through the 3ADI+ certification. The mix of media used in the campaign will be determined by the platform, with targeting advice from the PR/marketing firm. The table below shows some cost ranges for possible advertisements on different media channels, as estimated by industry professionals.

Table 49: Cost ranges for development and distribution of content on various media channels

Description	Actions	Estimated cost (USD)[72]	Notes
Television broadcasts			
Content development for 60 second clip, 20 & 30 second cut versions	Script writing, casting, filming and editing	20,000-30,000	Filming cost variable based on script
Circulation through electric media (to different TV channels) of 60 second clip	Communication and slotting with channels	25,000-40,000	Cost depends on the number and length of the showings per channel, which TV channel and time of airing
Cartoon, animation or talk show (development of one episode with telecast)	Concept development, script writing, content development and editing	15,000-25,000	Cost depends on channel and length of program
Live/on air broadcast	Communication and slotting with channels	15,000-20,000	Cost depends on channel
Reality show	Creative design, organization, filming	30,000-45,000	Cost depends on channel
Circulation of any program for broadcast	Communication and slotting with channels	20,000-25,000	Cost depends on channel
Telephone messaging			
Mobile SMS	Creative writing, content development and distribution	5,000-10,000	Cost depends on frequency of distribution and target group size
Radio promotion			
Dhaka radio stations, FM radio, community radio	Content development, scripting, audio recording and circulation	8,000-10,000	Cost depends on the number of radio stations engaged (with 13

[72] Costs do not include 10% tax or 15% VAT.

			community radio stations are available)
Online digital marketing			
Facebook, Instagram, Twitter, YouTube channel - with paid promotions	Content same as television clip	4,000-5,000	
Print media			
Newspaper article	Concept, content writing and editing	5,000-10,000	Cost per article in one newspaper, minimum of 10 articles; cost depends on positioning, length, publishing date
Create and circulate press releases	Communication and press conferencing with journalists	8,000-10,000	Recommended quarterly event
Bill boards			
Bill boards in targeted areas	Content, creative design, organization, installation	15,000-20,000	Targeted project areas
Bill boards national campaign	Content, creative design, organization, installation	35,000-70,000	All seven divisions of the country

Source: consultant interviews of industry professionals

4.5 Territorial aspect

Different zones of the country are more or less suitable for the interventions described above. The differences are based on the level of development of the livestock and dairy sectors, the quantity of milk production, and competitiveness of the actors in the segments. One of the early activities of implementation will be refining project targeting and selecting beneficiary communities. The table below summarizes the characteristics of the different zones, and proposes the business models and systemic interventions which would have the greatest development impact, and greatest likelihood of success, in each zone.

Table 50: 3ADI+ territories based on zone characteristics, with suitable business models and interventions

Category of zone	Criteria/description of the zone	Suitable 3ADI+ business models & interventions	Example districts
Primary milk zone (rural and peri-urban areas)	- Dynamic milk production and collection systems, with competition to purchase raw milk - Producer milk prices follow those established by industrial processors - Majority of cows HF cross-breeds with at least 50% exotic blood, fed in intensive system - Adequate or over-supply of AI and veterinary services - Intermediate traditional processors export chhana - Industrial processors operate extensive collection systems and process some milk in or near the zone	- Traditional processor institutes	Sirajganj, Pabna

Secondary milk zone (rural and peri-urban areas)	- Dynamic milk production, or over-production compared to capacity of collection systems - Producer milk prices follow those established by industrial processors, while traditional processors may pay less - Majority of cows HF cross breeds with at least 50% exotic blood, fed in intensive system - Farmers transitioning out of milk production to meat, due to lack of milk market demand - Adequate supply of AI and veterinary services - Traditional processors purchase milk locally - Industrial processors operate collection systems	- PPP milk collection hubs - Traditional processor institutes - SME industrial processors - Upstream activities of food safety certification - Educational marketing campaign	Rangpur, Dianjpur
Emerging milk zone (rural and peri-urban areas)	- Milk production increasing with NGO or institutional support - Producer milk prices variable and may be lower or higher than the industrial processor price - An increasing number of farmers have cross-breed cows, usually of less than 50% exotic blood, fed in mix of intensive and extensive system - Often inadequate supply of AI and veterinary services -Traditional processors purchase milk locally, and import chhana in lean season demand peaks - Industrial processor collection systems thin and remote from producers (only BRAC or BMPCUL)	- Livestock farmer associations and capacity building - Expanding collection systems of MCCs - PPP milk collection hubs (as production increases) - Traditional processor institutes - Upstream activities of food safety certification - Educational marketing campaign	Khulna, Jessore, Satkhira
Urban areas	- Milk production low compared to population density - Producer milk prices very high (>50 BDT/liter) - Majority of cows HF cross-breeds with at least 50% exotic blood, fed in intensive system - Adequate supply of AI and veterinary services - Traditional processors import chhana - No industrial processor collection activity; major factories located here	- Traditional processors could attend institutes in other zones - Downstream activities of food safety certification - Educational marketing campaign - Tannery worker training institute (in Savar)	Dhaka, Gazipur, and district center cities in the other zones

A fifth zone type, which could be called “non-milk zones” is not included in the table, as these areas will not be targeted in the intervention. In these areas, the population also keeps cattle, and even in similar densities to the other zones. However, the livestock sector is undeveloped and developing such areas is not the priority of the inhabitants or the governments. Most of the cows are local or sub-continent cross-breeds, except for a few large farmers in the urban or peri-urban areas. Several of these areas (for example the district of Feni) relay on remittances, which in some cases were used to start larger farms, while the small-scale farmers do not participate in an organized dairy value chain. Other such areas are focused on different agricultural commodities, such as tea.

4.6 Investment plan

In order to set up and launch the business models described above, capital investments will be made in equipment and technology, as well as in purchasing land and constructing civil works. While additional funds will be required for management costs, to fund capacity building and technical training, and other support activities, the capital investments make up the bulk of the program expenses. The table below summarizes the capital costs, which are also presented separately in each of the business model sections above and in the project budget in the Action Plan section which follows.

The investments in producer associations are for productive assets for association use, such as choppers, TMR wagons, milking machines, or other tools for livestock raising. Few capital investments are foreseen for the producers, as the objective of the intervention activities is to provide the farmers with markets and knowledge. The majority of the production costs of farmers are variable expenses, not capital costs. Once milk farming or bull fattening becomes profitable for the farmers, and they feel confident in their approach, (and know that their cattle will not fall ill and die, for example), Bangladeshi farmers have been seen to invest themselves in improved housing structures for cattle, and other construction and asset costs.

For the VMCCs, PPP hubs and training institutes, the 3ADI+ program will use a cost sharing approach involving co-financing of the entities to be constructed, equipped and launched. The co-financing approach will be further elaborated during program implementation. For the VMCCs, the entrepreneurs/cooperatives can be expected to finance the investments in land and civil works, while 3ADI+ would undertake most of the identification and procurement of equipment and technology. The local governments are unlikely to be able to finance any part of the construction requirements of the hubs, so the entirety of these capital investments would be financed by the program budget. The partner universities or NGOs may have the financial resources to finance all of the establishment of the traditional processor institutes, or may only be able to allocate land or a building to be renovated. Therefore, again, the majority of the required expenditures will be included in the program budget. For the three slaughter house varieties, the investments in structures have been included in the category of investments in equipment and technology, as the infrastructure needed is highly integrated with the machines and functionality of the slaughter facilities. All of these costs will be included in the 3ADI+ budget, while the local governments would allocate land which they likely already own. Therefore, no value has been shown for an investment in land and civil works for the slaughter facilities.

Table 51: Proposed capital investments for the core value chain business models

Core value chain business model	For one entity (USD)		Number of entities planned	For all entity (USD)	
	Investment in equipment & technology	Investment in land & civil works		Investment in equipment & technology	Investment in land & civil works
Primary producers (associations)	2,000	0	750	1,500,000	0
Village milk collection centers	35,661	4,000	75	2,674,564	300,000
PPP milk collection hub	1,495,570	1,261,138	5	7,477,850	6,305,691
Traditional processor training institute	23,381	70,000	5	116,905	350,000
Large slaughter facilities	7,700	0	20	154,000	0
Market slaughter facilities	1,200	0	20	24,000	0
Roadside slaughter facilities	635	0	20	12,700	0
Totals				**11,960,019**	**6,955,691**

5. Action plan for the development of the value chain

5.1 Concrete goals and objectives

Since the livestock (cattle) value chain in Bangladesh is diverse and contains various internal sub-value chains, three strategic tracks, with distinct goals and objectives, have been defined. Overall, the ultimate objective is to increase the quality and value produced in the chains, by bringing knowledge and technology to farmers, collectors, processors and slaughters/butchers, in order to improve their organization and processes. Interventions at the systemic level in food safety and transparency, markets, and trade associations, reinforce the improved processes used by actors in the different value chain channels.

Strategic track 1 (industrial dairy value chain): Within five years, by 2024, the industrial dairy value chain will be expanded to include 15,000 more small-holder farmers, who will use best practices in farm management to produce a larger output of higher quality of milk, and who will be organized into over 300 farmer associations. The farmers will sell milk to seventy-five village milk collection centers (VMCCs), that will be launched by local entrepreneurs and producer cooperatives, and which will purchase milk from farmers for resale to PPP milk collection hubs. Five PPP milk collection hubs will be launched by local governments in the secondary and emerging milk zones of the country, and will be operated through partnership/leasing agreements by private sector companies. The milk sold by the hubs will equate to over 20% of the milk equivalent sold in dairy products by industrial sector companies, at 2024 quantities. The PPP hubs will also operate a food-for-milk scheme to provide concentrate feeds to farmers at discounted prices, reducing the farmers' expense for the largest production cost in milk production. The reduced cost concentrate, together with the other best practices taught to the farmers, will increase primary milk production profitability by over 150%. The VMCCs and PPP hubs will also operate profitably, and generate 425 quality jobs in rural and peri-urban areas, while also providing a profit share to the farmers and the local governments. Upon reaching capacity operations, the hubs will collect nearly 55,000 tons of milk annually, which will be sold to industrial processors, large traditional processors, and in pasteurized and packaged form to distributors/retailers in surrounding cities. (Strategic track 1 relates to Outputs 2 (producers), 3 (aggregation), and 4 (aggregation and processing), described below)

Strategic track 2 (traditional dairy value chain): Within five years, by 2024, five training institutes will be launched by 3ADI+ project partners, to provide training on the best practices in traditional dairy processing to the makers of traditional products (sweetmeats, curd and ghee), and to provide access to the basic laboratory tools and processing technology needed by the traditional processors to apply these best practices. The training institutes, which will operate as social businesses by charging for courses and selling the tools and equipment, will train over 2,000 traditional processors annually, once reaching capacity operations. Traditional processors will increase profitability by 50% by applying the knowledge gained in the trainings. Over 3% of the traditional processors in the country will be trained annually, or over 13% during the program duration, with training continuing indefinitely after the conclusion of 3ADI+ in Bangladesh. In order to secure the quality milk necessary to produce higher value products, the traditional processors will test the milk they purchase from collectors, and incentivize collectors to provide quality, unadulterated milk. The collectors will in turn seek higher quality milk from farmers. The 3ADI+ stakeholder platform will thus also support an additional 15,000 farmers, to be organized into over 300 farmer associations, to improve their management practices and milk quality. These farmers will supply the clusters of traditional processors, and to sell milk at the elevated prices paid by the processors in these zones. The 3ADI+ platform will reinforce and support the quality and value gains in the traditional dairy value chain through system-focused interventions, including developing a food safety certification with a traceability system, to be implemented and operated by a food safety authority in the country, and launching an educational marketing campaign focused on the consumers of traditional products, educating them about the criteria for safe dairy, and building demand for quality, safe products. National-scale trade associations will also be established for each of

the value chain segments of cattle farmers, collectors and traditional processors, with members trained on how to participate in the national policy dialogue, to advocate for their commercial interests. (Strategic track 2 relates to Outputs 2 (producers), 5 (traditional processors), 7 (certification), and 8 (educational marketing, described below.)

Strategic track 3 (beef value chain): Within five years, by 2024, 60 slaughter facilities will have been upgraded and constructed, including 20 of three different types: large urban facilities, market facilities, and roadside facilities. The facilities will be used by over 1,600 butchers, to slaughter over 500,000 animals annually. The slaughters/butchers will receive training on the techniques for hygienic meat production, and the slaughter facilities will provide the infrastructure and machines to comply with national standards for safe meat production. As a result, over 10% of the meat produced during most the year in the country will be safe for consumption, equivalent to 5% of the total meat production, when including the cattle slaughtered for the Eid al-Adha sacrifice. Butchers will experience a 30% increase in profitability; the associations/enterprises which manage the slaughter facilities, and the local government which owns the infrastructure, will benefit financially. The trainings and organization at the primary milk production segment will also benefit farmers supplying cattle for meat, as many of the milk farmers also supply either old milk cows or fattened bulls for meat. The systemic-level interventions targeting food safety and traceability, markets, and associations, will also support and reinforce the coordinated upgrades to the beef value chain. (Strategic track 2 relates to Outputs 2 (producers), 6 (slaughters/butchers), 7 (certification), and 8 (educational marketing), described below.)

5.2 Concrete actions

Output 1 (Strategic planning and piloting): The 3ADI+ stakeholder platform is formed with the roles of partner institutions defined; the geographical scope and territories for implementation are defined; and, pilot business models/interventions are implemented and evaluated.

Activity 1.1: Identify partners and 3ADI+ platform members, and develop MOUs/contracts to define roles. Select the key partners who will form the stakeholder platform, which will provide overall guidance to the project, overseeing and participating in strategic planning and implementation. Key organization types to include the national government counterpart organizations (in livestock extension, research, food safety, etc.), agricultural university research systems, industry trade associations, local governments of targeted districts, and others. Certain partners may be involved in strategic planning and monitoring, while others may be more directly involved in implementation, with still others providing both functions. Each of the eight core business models and three system interventions will be led by a platform partner, which will either assure the implementation or subcontract the implementation and provide monitoring and guidance. Platform partners will be selected based on (1) expertise in the related sector, (2) skills, network and knowledge which each can make available to the project, (3) human resources/staff availability to dedicate to project planning and implementation, and (4) willingness to provide additional resources including not only staff time, but also financial and in-kind contributions.

Activity 1.2: Identify the geographical scope of implementation and select target territories. The 3ADI+ stakeholder platform will identify the geographical regions of the country which are most suitable for implementation of the program, and within these areas select the targeted territories. Selection criteria will include (1) the appropriateness of the various business models to the development of livestock and milk production in the area, (2) supportiveness of national livestock development strategy and government priorities, (b) reasonable probability of success of development interventions within project time horizon, (c) vulnerability of communities to natural disasters, (d) impact potential in income generation, employment creation, and poverty alleviation, (e) adequate financial and technical resources to match project activities and make material impact, (f) complementarity and/or duplication avoidance in relation to prior, ongoing, or proposed donor/government initiatives and (g) usefulness for providing effective development models in targeted value chains. DLS will provide

guidance in selecting the territories. Additionally, the type of zone (primary, secondary, or emerging milk zone, or urban areas) most suitable for each of the business models was described for each in the section of the report on upgrading opportunities.

Activity 1.3: Implement and monitor pilot projects, and conduct evaluation. Implement various pilot projects in the selected territories to test the impact of the proposed business models and interventions, as well as the modality of intervention. Pilot projects to implement include (1) forming associations of small-scale dairy farmers and delivering the capacity building training, (2) supporting the launch of small scale village milk collection centers (VMCCs) to expand the collection systems of an industrial dairy processor, (3) upgrading the technology and process of traditional dairy processors, (4) upgrading the infrastructure and machines in slaughter facilities (one of each type), as well as the capacity of the butchers to comply with food safety standards. Three to five pilots will be implemented for each of the four initiatives/business models. Interviews will be used to collect financial and socio-economic data on the beneficiaries and their business activities, prior to implementation, and at regular intervals, to analyze the impact of the proposed upgrading models. The results for the beneficiaries and the efficiency of the implementation process, will be reviewed to formulate improvements before rollout of the overall project by the 3ADI+ stakeholder platform.

Output 2 (Primary production): Cattle farmers are organized and practices improved, with farmers working through registered associations/cooperatives to achieve increased milk production quantity and quality, self-monitoring of animal health, and participation in the feed-for-milk scheme of the PPP milk collection hubs.

Activity 2.1 Develop and implement a methodology to select farmer beneficiaries. A selection methodology will be developed targeting the territories for project implementation. As the project will target areas appropriate for milk collection systems supplying the PPP hubs, and areas with clusters of traditional processors, an approximately equal number of farmers will be selected to supply both types of buyers (industrial and traditional). The methodology will combine an approach of mobilizing populations to participate in the project, and also requiring that they apply through an application process. Lead farmers will have the opportunity to form groups, and to apply in the name of the group. Lead farmers may apply with new groups which were not already organized as entities, or existing associations or cooperatives may apply. The focus will be on identifying producer groups where self-initiative and motivation already exists. Then a prioritization process will be undertaken for determining existing and potential producer groups with the most promise for meeting project objectives. Prioritization criteria will include the reasonable probability of assistance success, the number of people who will benefit, possible employment generation, the involvement of women and youth in the groups, including as leaders, and the potential for expanded revenues and profits. The applicant groups will be scored according to the identified criteria and the highest scoring groups selected. The 3ADI+ platform partners responsible for implementation of Output 2 will evaluate the applicants, select beneficiaries, and report the selection to the platform members.

Activity 2.2 Create or revitalize farmer associations and/or cooperatives. The 3ADI+ platform partner will work with the selected producer groups to build a common understanding among their members, prioritizing trust and equitable power relations between members. Specifically, 3ADI+ assistance will include support in (1) meeting with prospective members to explain opportunities and risks (2) developing a joint vision and mutual accountability, (3) reviewing options as to the legal and organizational structure, (4) developing by-laws and organizational and administrative structures for the option chosen, (5) advising on legal and other steps necessary to become officially registered and operational, and (6) assisting with the formal establishment of the producer groups, to include formation of boards, and elections of board members and officers. Generally, farmer groups will be registered as associations, as their purpose is self-monitoring, capacity building, and improving linkages with service providers, rather than having a common business purpose. However, those groups with the capability and interest to engage in a business activity together, such as the collection and sales of milk as a business entity,

will be registered as cooperatives. Some of the associations may upgrade/transform their activities and re-register as cooperatives within the duration of the project.

Activity 2.3 Facilitate the delivery of capacity building and services, with monitoring and support to farmers. A capacity needs assessment will be conducted for each group before engaging in practice-based trainings and coaching activities. Training modules will be developed as a guide to the trainings, and the different modules delivered to the producer groups based on the results of the needs assessment. The topics of the modules and associated training will include (1) improving feeding practices for maximum milk quantity and quality (as well as meat bulking for fattening), (2) reducing the birthing of calves to interval to every 12 months, (3) improving calf care to prevent malnutrition and reduce mortality, (4) improving cattle health with a focus on preventing the most common health issues which also impact cattle mortality and milk production, (5) record keeping so that farmers can understand the profitability of their livestock business, and evaluate the impact of adopting the various practices, and (6) other relevant topics when necessary (including introducing fodder production, silage production, feeding related technologies, biogas digesters, housing designs to reduce disease, parasites, and heat stress, and other improved farm management techniques). The training will be delivered by the 3ADI+ project partners (DLS, regionally focused NGOs, etc.) or outsourced via subcontract. Training and coaching of farmer groups will continue throughout the 3ADI+ project, with periodic evaluation of farmer groups to assess improvements in their practices. The focus of repeat trainings will be determined based on the results of the evaluations. The 3ADI+ project partners will analyze why any of the trainings are not being adopted by the famers, to identify cultural, financial, social or other constraints, in addition to the lack of knowledge. In the case that physical assets are required for successful upgrading of farmer practices (such as to construct a biogas digester), the 3ADI+ platform will assist the producers to link with microcredit institutions, as well as providing the technical support for construction and operation. The project will provide limited levels of financial assistance to selected producer groups for the purchase of key inputs and equipment required for their establishment and strengthening.

Activity 2.4: Reinforce the functionality of the associations to monitor the health status of members' cattle. Given the endemic nature of many of the cattle diseases, the productivity reducing impact of these and other animal health issues, and the massive insufficiency of human resources in DLS and its development partners to provide the farmers with veterinary and other services, a special focus will be on supporting the primary producer associations and cooperatives to self-monitor the health of their animals, and to seek the necessary health services. In addition to the trainings on animal health (in Activity 2.5), the producer groups will be supported to develop and implement methods, based on cohesion and group compliance, to ensure that member farmers implement the best practices in the prevention of disease, parasites, mastitis, diarrhea, etc. Systems will be established through which group members self-report the entry of new animals (which could be carrying disease) into the zone of the association, in an effort to reduce the prevalence of disease in the areas under their supervision and to protect their animals. Similarly, the farmer groups will serve as the organizing principal which will improve the efficiency of the delivery of animal health services. To the degree possible, they will act in concert to request vaccination and other services from DLS and development partners, and will possibly be able to negotiate group pricing. In this way, they will also be supported to become more responsive to the services which are currently offered.

Activity 2.5: Facilitate the linking of farmer associations and cooperatives to the feed-for-milk scheme of the PPP milk collection hub. The 3ADI+ platform partner responsible for training and supporting the farmer associations and cooperatives, will also assist these associations to link with the feed-for-milk scheme to be implemented through the PPP milk collection hub (described in Output 4). Farmers will receive support designing logistics and understanding the financial benefits of participating in the scheme. Since the feed-for-milk scheme

will be operated by the PPP hub, only those farmers suppling milk to this system will be connected with the feed-for-milk scheme.

Activity 2.6: Federate the producer associations, and link them with other farmer organizations at a national scale, and enhance their ability to influence trade relationships and policy making. In spite of their economic importance and of the nation's population and workforce, rural areas and livestock farmers are under-represented in the establishment of laws, regulations, investments, and plans which affect them. To address this, 3ADI+ will form the livestock farmers' union, whose primary function is not production or value addition, but representing the interests of the farmers in the adoption of laws and regulations, and the allocation of public resources, both human and financial. It will also educate producers as to how to effectively monitor, understand, and influence the political process in Bangladesh, both locally and nationally. Care will be taken not to duplicate existing structures, a union of livestock farmers' associations/cooperatives will be created – initially in the territories in which the 3ADI+ interventions are targeted, but also expanding to encompass the entire country. While the government owned milk processing company, the Bangladesh Milk Producers Cooperative Union Ltd, is also a union, it includes only its suppliers. The independent livestock farmers' union to be formed, will not be limited in scope by being within the supply chain of any particular processor, business entity, or government organ.

Output 3 (Aggregation): Milk collection system expanded in proximity to farmers to supply the PPP milk collection hubs, and/or the industrial dairy processors.

Activity 3.1 Develop and implement a mythology to select milk collection entrepreneurs/cooperatives. In much the same way that producer groups were selected, the 3ADI+ stakeholder platform partner responsible for the implementation of Output 3, will select the entrepreneurs and/or cooperatives to establish milk collection centers in proximity to the milk farmers. The selection criteria will be adapted to the collectors, who will be local individuals with entrepreneurial experiences or aspirations (with an emphasis on women and youth), or the most capable of the farmer cooperatives described in Output 2. (The geographical territory for Output 2, 3 and 4 will overlap, as the collection centers to be established will collect the additional milk produced as a result of Output 2.)

Activity 3.2: Support entrepreneurs/cooperatives to develop bankable business plans and to secure financing. The 3ADI+ implementing partner will assist in the preparation of initial business plans and budgets, the identification of sources for start-up capital, and the process for securing this capital. The selected entrepreneurs and cooperative leaders will develop the business plans using templates and formats provided through 3ADI+, and by adopting the basic business model presented in the Upgrading Opportunities section of this report. The entrepreneurs will be coached in analyzing the situation of milk supply, requirements for collection and distribution, and the markets/buyers of fresh milk in their area. Support will be provided to determine the financing required, in terms of capital investments and working capital, and the entrepreneurs will receive support in applying for grants and linking with microcredit institutions. Such activities will be delivered, where possible, by national/local service providers who will be capacitated to provide services beyond the duration of the project.

Activity 3.3 Support entrepreneurs/cooperatives to secure land and construct/renovate facilities. Before 3ADI+ delivers financial support in the form of productive assets, the entrepreneurs/cooperatives will complete the construction of the structures/buildings for the milk collection sites. In most cases this will be rental and renovation, or construction, of simple one room buildings. The 3ADI+ implementing partner will provide the entrepreneur with the necessary support in providing construction designs for the physical structure of the collection center, and in any other technical aspects required.

Activity 3.4 Procure and set-up chilling equipment and milk testing laboratories using a matching grant facility, and capacitate entrepreneurs/cooperatives in the technical use of equipment. The 3ADI+ platform, based on

cost-sharing models and having facilitated access to other means of finance, will support producer groups to acquire the most appropriate technical equipment and machinery, and complement existing capacities to enable the collection, testing, storage and sales of high quality milk. Since many collection centers will be established during each year of the project, the 3ADI+ platform stakeholder will manage the procurement of key equipment to secure economies of scale in purchasing. Therefore, matching grants, delivered in the form of equipment and technology, will be used to procure and set-up processing and laboratory equipment, with a focus on energy saving technologies. Once the equipment is set up, training and coaching will be provided to operate the collection facility efficiently and necessary skills among entrepreneurs, group members and employees will be built. Among these skills are quality control, collection management, reception and testing of milk, maintenance of machineries, and operation of machineries. These skills will be communicated via training courses, on the job demonstrations, as well as through visits to existing milk collection centers.

Activity 3.5 Train entrepreneurs on milk quality issues and support them to launch and expand business operations. The 3ADI+ implementing partner will support entrepreneurs to develop organizational and entrepreneurial skills through practice-based training and business coaching. The training will build capacities in group organization, business planning, administration, accounting, work organization, and hiring and managing staff. Entrepreneurs will receive support in securing the necessary operational licenses and certifications, and complying with food safety standards. Implementing partners will also train selected staff of targeted producer groups to develop marketing capacities, and support to link them with local buyers of milk. Overall, entrepreneurs will receive support to implement their business plans through regular coaching sessions, mentoring and troubleshooting of the inevitable challenges. Such activities will also be delivered, where possible, by national/local service providers who will be capacitated to provide services beyond the duration of the project.

Activity 3.6 Form and expand milk collector associations, and capacitate them to influence trade relationships and policy making. There is no industry association for milk collectors, and many of them operate in the informal sector and are unregulated. In the development of the dairy sector, their interests are usually overlooked. There is no recognized best practice in milk collection, except the policies implemented by the industrial dairies in their collection schemes. In order to create better horizontal linkages in the aggregation segment of the value chain, an industry association of milk collectors will be established, with chapters in the different target territories of the 3ADI+ initiative, to be expanded to cover the entire country. The 3ADI+ project platform will form the milk collectors' union, whose primary function is to represent the interests of milk collectors in the adoption of laws and regulations, and the allocation of public resources. It will also educate collectors as to how to effectively monitor, understand, and influence the political process in Bangladesh, both locally and nationally. The association will enable the creation of networks, exchange of information about prices and best practices, about business opportunities, and enable knowledge and technology to reach ever more collectors.

Output 4 (Aggregation and processing): Milk collection hubs, with pasteurization capacity, operated as Public Private Partnerships, launched and collect milk, to sell nationally.

4.1 Select locations for hubs and local governments allocate land. Within the selected territories for the implementation of Output 2 and 3, the 3ADI+ platform partners will discuss with the local government authorities to determine the best partner and location for the PPP milk collection hubs. The hub will be at the center of the VMCCs, with each of the VMCCs not more than 50 km from the hub. Prioritization criteria for selecting the local government partner will include the motivation of local government leaders, willingness to invest local resources, including time as well as financial resources, and the leadership capability of the government heads. As the hubs will be owned by the selected local governments, it is essential that the government partners clearly understand their role, responsibility and benefits, in partnering with 3ADI+. The availability of land in the area will also be an important factor. In selecting the site, the reasonable probability of assistance success, the number of people who

will benefit, possible employment generation, and the potential for expanded revenues and profits of upstream value chain actors will be important conditions.

4.2 Develop business plans for specific hub locations. The basic PPP hub business model will be adapted to the specific site where the hub will be located. Adaptation includes analyzing the quantity of milk available, and forecasting quantities available following 3ADI+ implementation, as well as analyzing and seeking initial agreements with potential buyers. The potential to supply milk to the hub will be discussed with VMCCs, producers and other milk collectors in the region. At this point possible private sector partners will also be engaged, with both options explored: outsourcing the management of the hub, or a closer integration with a private company. The local government and the 3ADI+ team will analyze the cluster services to include at the hub, including microfinance for farmers. All of the other costs will be investigated at the local level and included in the plan. While the bulk of the financing will be provided through 3ADI+, the platform partners will support the local government in determining any additional financing required, and in establishing linkages with potential funding partners and financial institutions.

4.3 Support local governments to adapt designs and construct the infrastructure for the hubs. Local governments will hire engineering firms to adapt the hub design included in the report to the local conditions, and according to the planning included in the business plan. 3ADI+ will assist in interactions with engineering firms, and could engage a single firm to adapt the designs for all of the hubs to be constructed in the context of the project, for cost savings. With guidance and consulting from 3ADI+, and using the designs, the local governments will develop the site and undertake the civil works.

4.4 Support local governments to procure and set-up chilling and processing equipment, and milk testing laboratories. The 3ADI+ platform, based on cost-sharing models and having facilitated access to other means of finance, will support the local governments to acquire the most appropriate technical equipment and machinery, and complement existing capacities to enable the collection, testing, storage and sales of high quality milk. The 3ADI+ platform stakeholder will manage the procurement of key equipment to secure economies of scale in purchasing. The program will maintain a focus on using energy saving technologies and constructing ETPs and other mechanisms to reduce waste and improve the impact on the natural environment.

4.5 Launch and award tender for management company of hub, and capacitate staff in the use of technical equipment. Continuing the negotiations initiated in Activity 4.2, the company which will lease the infrastructure from the local government to run the business operations of the hub will be selected, following the stipulated procedures, and agreements will be signed. If the companies selected to operate the hub is a start-up business, then 3ADI+ will support the entrepreneur in securing the necessary incorporation certificates, trade licenses, environmental clearance certificates, BSTI (Bangladesh Standards and Testing Institute) quality certification BFSA (Bangladesh Food Safety Authority) certification, Local municipal authority permission & NOC (no objection certificate), and any other required permissions. Once the facilities are established and functional, training and coaching will be provided to the staff of the company selected as operator. Among these skills are management, quality control, collection management, reception and testing of milk, maintenance of machineries, operation of machineries, and marketing and sales. These skills will be communicated via training courses, on the job demonstrations, as well as through visits to similar hubs in the country.

4.6 Support implementation of feed-for-milk scheme, and milk collection & processing. The 3ADI+ platform will support the operating business, in partnership with the local government, and in consortium with DLS, to establish and operate the systems which the PPP hub was constructed to facilitate. The feed-for-milk system is one of these systems. Prior to launch the operating business will hold a tender and negotiate the best price possible for feed be distributed to farmers through the scheme. The operations of the scheme will be discussed with the feed

company, the VMCCs, and other partners, with the role of each of the partners clarified. The 3ADI+ partner responsible for creation of producer associations and upgrading of farmer groups will support in establishing the linkages with the producer groups. Similarly, the method of purchasing milk through the VMCCs, together with supply routes, will be established and launched. 3ADI+ will also support in identifying potential buyers, both companies and distributors, as the networking and knowledge of the 3ADI+ platform will likely be wider than that of the operating company. The operating business will begin collection, storage, processing and sales operations.

4.7 Coordinate cluster services, including MFIs to open offices in hubs. The necessary tendering and agreements will be completed to select the service businesses, including but not limited to microfinance, which will operate from the hub structure. Businesses may rent office space, or other space such as of a cold room for refrigeration.

Output 5 (Traditional dairy processing): Processing methods of traditional dairy processors innovated and standardized, with producers producing safer products of higher value.

5.1 Select institutions to host the traditional processor institutes, and sign MOUs/partnership agreements. Institutional members of the 3ADI+ stakeholder platform may host traditional processor institutes, and other institutions, such as universities or NGOs with programs being implemented in the territories selected for 3ADI+ implementation, may also host institutes. In selecting potential partners, criteria will include the alignment of the organizations mission with 3ADI+ objectives, capacity of leadership and staff, track record and experience in the dairy industry and in implementing similar programs, network in the area and relations with communities and community leaders in the targeted territory, and willingness to invest human, financial and other resources. Agreements will be developed with roles and responsibilities of 3ADI+ and the partnering organizations.

5.2 Develop training curriculum, and support host institutions to develop business plans for institutes. The 3ADI+ partner leading the implementation of Output 5, will coordinate the development of a curriculum for the host institutes, including practical training based on using laboratory tools to test milk, and demonstrations of preparing sweetmeats and other traditional products. The training curriculum will be practiced based in that the traditional processors taking the courses will prepare the products together with the professors and technical advisors to understand the upgrades in processing protocols and experience the resulting difference in product quality. Training topics will also focus on food safety, techniques for maintaining a hygienic processing area, typical foodborne illnesses and their sources and effects, milk quality, content, and other topics. In addition to developing the curriculum the 3ADI+ partner will assist the organizations to adapt the business model presented in this report, to develop site and organization specific business models. The business models will analyze the number of potential students, class fees required to breakeven as a social business and the other revenue streams; as well as analyzing the costs, including operational costs, human resource costs, and sourcing costs for the milk testing technology to be sold to students. 3ADI+ will initially assist with procurement of the equipment in order to gain scale discounts across the institutes.

5.3 Support host institutions to secure land, construct or confirm institute buildings, and equip the institutes. Of the universities and NGOs which will host the institutes in the different 3ADI+ territories of the country, many already own land and have training facilities. These facilities may need to be expanded or adapted to house the institutes. While the equipment required for making traditional products is simple and inexpensive, 3ADI+ will also offer guidance on selecting the best equipment. Depending on the partner institution and its available resources, 3ADI+ will work on a cost sharing basis to construct and equip the institutes.

5.4 Support host institutions to staff the institutes; support instructor training, with outreach activities to processors/students launched; and support institutions to optimize institute operations as social businesses. The 3ADI+ leading partner for Output 5 will support the institutes to the degree necessary to select staff and train instructors. The format will be a training of trainers provided to instructors from the lead instructors of the central

training institute, most likely to be housed at BAU. 3ADI+ will also provide support in launching and operationalizing institute as a social business, to the degree required by the partner organization. Support will include designing outreach activities to traditional processors, who could be potential students, as well as management and finance trainings and support in operating as a social business.

5.5 Support host institutions to monitor and evaluate the result/impact of the training on processor business, and product quality in the value chain. The ultimate purpose of the training institutes is to increase the quality and value of the products created by the traditional processors; boost their profitability; provide safer, higher quality, and affordable food to the population; and, to create and upward pressure on milk quality in the upstream segments of the value chain, eventually incentivizing farmers with markets to provide better care and feeding to their cattle, and also boosting their profitability. In order to track and analyze whether the wide ranging expected benefits from the intervention with the traditional processors is achieving the correct impact, 3ADI+ will assist the organizations hosting the institutes to design monitoring and evaluation methodologies. The methodologies will be implemented with the direct and indirect actors, to determine impacts. The organizations will use the data and knowledge from the evaluations to adjust teaching methods and institute operations.

5.6 Form and expand traditional processor associations, and capacitate them to influence trade relationships and policy making. There is no industry association for traditional processors, and many of them operate unregulated. There is no recognized best practice in milk collection. In order to create better horizontal linkages in the traditional processing segment of the value chain, an industry association of traditional processors will be established, with chapters in the different target territories of the 3ADI+ initiative, to be expanded to cover the entire country. The 3ADI+ project platform will form the traditional processors' union, whose primary function is to represent the interests of traditional processors in the adoption of laws and regulations, and the allocation of public resources. It will also educate traditional processors as to how to effectively monitor, understand, and influence the political process in Bangladesh, both locally and nationally. The association will enable the creation of networks, exchange of information about prices and best practices, about business opportunities, and enable knowledge and technology to reach ever more processors.

Output 6 (Slaughtering/beef processing): Slaughter facilities upgraded and new facilities constructed to standardize processes and enable slaughters/butchers to comply with food safety standards.

6.1 Select locations for slaughter facility renovation, upgrading and new construction, with planning confirmed with local governments and design options discussed with stakeholders. Unlike many of the other outputs, Output 6 targets primarily urban areas as they represent the densest consumption markets for beef. The 3ADI+ platform partners will discuss with the local government authorities to determine the best partner and location the upgrade slaughter houses. The local government authorities will in most cases be city corporations or municipality governments. As the slaughter facilities are owned by the selected local governments, it is essential that the government partners clearly understand their role, responsibility and benefits, in partnering with 3ADI+ on the upgrade. With each local government partner, the 3ADI+ implementing partner will analyze with the government the best option for upgrading the slaughtering situation. These options include the different solutions suitable for the different categories of slaughtering areas defined in the report, as well as variations on the design proposals. In selecting the sites and designs, the reasonable probability of assistance success, the number of butchers and slaughters who will use the facility, their openness to using new technology and improving slaughtering methods, discussion of the additional costs, consumers and other people who will benefit, possible employment generation, and the potential for expanded revenues and profits of upstream value chain actors will be important conditions. After the basic conditions for the upgrade have been agreed with the local governments, the variables of the design – such as the machines to be installed, the changes in running costs, the required changes in slaughtering methods, and alterations in the business models of all parties involved will be discussed

in co-design teams, to determine the final versions to be constructed. These teams will include representatives of the local government, management committees (which will be created if none exist), meat traders' associations, butchers, slaughters and 3ADI+.

6.2 Renovate, construct, equip facilities and laboratories, and provide meat distribution vehicles. The 3ADI+ platform, based on cost-sharing models will support the local governments to renovate or construct, and equip the slaughter facilities with the identified machines and laboratories. Since many facilities will be upgraded during each year of the project, the 3ADI+ platform stakeholder will manage the procurement of key equipment to secure economies of scale in purchasing. Therefore, matching grants, delivered in the form of equipment and technology, will be used to procure and set-up processing and laboratory equipment, with a focus on energy saving technologies. Refrigerated meat transport vehicles will also be procured by local governments and provided for use by the slaughter house oversight committees/associations.

6.3 Train slaughters/butchers on safe/hygienic methods of slaughtering and butchering, on how to use the improved machines and facilities, and on designing meat distribution routes using the delivery vehicles. Once the equipment is set up, training and coaching will be provided to operate the slaughter facility efficiently and as well as to build the necessary skills among slaughters and butchers to provide safe meat to consumers. Slaughters and butchers will be trained on aspects of food safety, how to prepare safe meat, foodborne illnesses, sources of contamination, and on how to use the new equipment correctly to prepare meat in accordance with food safety standards. The meat distribution vehicles will be used by the associations managing the slaughter facilities to distribute meat to other markets, and the service fee for delivery, distribution routes and other aspects will be developed by the associations with 3ADI+ support.

6.4 Support stakeholders (local governments, facility/market management committees, butchers) to implement usage of the new facilities, and undertake monitoring and evaluation of safer practices. 3ADI+ will play a facilitating and convening role to ensure that the usage procedures, costs and business model changes are clearly understood by the entities responsible for the different aspects of the facilities use and management. The program will support the institutions to adjust their mode of operations and expectations, in order to smoothly adapt to using the new facilities. 3ADI+ will design and implement a monitoring and evaluation system which will on the one hand analyze the impact of the upgrade in terms of socio-economic impact on actors, and on the other inspect and monitor the facilities to ensure correct usage and the output of a quality, safe product.

Output 7 (Food safety and traceability): Food safety and traceability certification agency developed as social business, to reinforce food safety good practices among beneficiaries and beyond.

7.1 Select/verify agency which will operate the certification and traceability social business initiative, and develop business plan. Just as with the other outputs of the 3ADI+ initiative, a platform partner will lead the implementation of activities to establish and launch the food safety certification social business. BFSA is the partner best positioned to play a coordinating role. However, since food safety is implemented by the local governments and other government ministries and institutions across the country, a consortium of organizations could implement aspects of Output 9.

7.2 Develop certification criteria harmonized with Bangladeshi standards, and training curriculum for different value chain segments. The actors of the different value chain segments will receive training and ongoing coaching to upgrade their processing methods to comply with hygienic and food safety standards of the country. The bulk of this training will be delivered by different 3ADI+ implementing partners, with responsibility for leading interventions within the different value chain segments, including primary producers, milk collectors, traditional and SME industrial processors, and slaughters/butchers. The 3ADI+ partner responsible for implementing the food

safety and traceability system, will have the most expertise in these aspects, and will consult and contribute to the capacity building modules developed for trainings of the actors in each of the segments.

7.3 Develop the traceability system focusing on the dairy and beef value chains, including set-up, monitoring and auditing methodologies. The 3ADI+ platform partners specializing in food safety and leading these aspects of the intervention will develop and implement the system. Overall, creating the traceability system involves defining the unit of raw material or production that will be traced, to establish forward, backward and internal traceability. Each product will be included within an identification system, and labeled with an ID (identification) to create a link between the identified product and the information recorded about that product. The ID may initially be a stamp or label, but could involve electronic tags. The value chain actors will keep records about the products, including contact details of suppliers and buyers, dates of delivery, batch numbers, quantities supplied and sold, and other records. While the information may initially be kept by paper documents, the process will evolve to use an electronic database, or electronic tags. The 3ADI+ partner will also monitor and periodically arrange audits of the process.

7.4 Develop the communication methods of the certification, including the logo, and outreach methods. The certification will be represented by a recognizable logo, which traditional processors can display on their shops and products, and which the industrial SMEs can include on package labeling. The certification will be a symbol of quality and guarantee to producers that the products meet food safety criteria, and that a degree of traceability has been established for all inputs. This logo will be designed by a graphic design or PR firm and registered with the government. The logo can also figure on outreach materials and media used to communicate the benefits of the certification to more value chain actors, who could be certified.

7.5 Launch the certification social business within the food safety authority, train staff on methodologies, and undertake operationalization. The operations of the certification of food safety and traceability system will be developed to function sustainable over time. Companies and individuals wishing to be certified will pay for the training courses and certification, and re-certified annually, at a cost which is less than the premium in prices they are able to charge, because of having the certification. Given the income from the courses and certification process, the proposed certification agency can operate as a social business unit, while housed within a Bangladeshi food safety authority. The social enterprise will for charge the inspections, evaluations and coaching required to receive the certification, the unit will eventually operate sustainably. After establishing the certification and traceability system, the food safety authority will begin to operate the unit as a social business. This tradition will occur after the certification operations are functioning well, and procedures have been developed and verified.

7.6 Evaluate the impact of the certifications on project beneficiaries, consumers and other stakeholders, and expand the reach of the certification system. The result of the food safety and traceability system will be monitored on a regular basis and audited to verify functionality and compliance. Also, the permanence of the change in the hygienic and safety methods of producers, collectors, processors, and slaughters/butchers will be evaluated to verify impact and determine topics for additional learning. The 3ADI+ platform will also evaluate the impact on consumers and other stakeholders through interviews and consumer studies that analyze the change in purchasing behaviors as a result of publicizing the certification, at the local, regional or national level as implemented.

Output 8 (Educational marketing campaign): Social marketing campaign implemented, educating consumers of traditional dairy products and fresh beef about food safety and nutrition, expanding demand for safe food products.

8.1 Determine geographical and segment targeting of educational campaign, and select traditional and social media channels to use. The 3ADI+ platform partners will define the audience to reach though the social marketing

campaign. Aspects to consider will be demographics, such as gender and age (with emphasis placed on reaching young people), and other aspects of the target population which may make them more open to behavior change regarding purchase decisions, including attitudes, values, motivations, cultural aspects, and economic class/purchasing power. The campaign will be carried out in the consumption zones of the products supported by the project. The 3ADI+ platform will also identify the indicators which the campaign is aiming to change, to use in evaluating impact, and conduct baseline studies of consumers. Based on the target population and the desired changes in purchasing behavior, the media channels to use to disseminate the message will be selected. Media channels may include television broadcasts (of commercial clips, cartoons/animations, reality shows, talk shows), SMS messaging, radio promotion, digital social marketing (Facebook, Instagram, Twitter, YouTube, etc.), newspaper, and/or billboards. Indirect communication methods, including influencing the target population through religious leaders such as Imams, local government officials, or influential community members will be included. As a result of the activity, the structure of the campaign will be defined.

8.2 Develop the messaging and content of the advertising campaign, highlighting the certification logo. The 3ADI+ platform will develop the messaging to be dispersed through the structure of the advertising campaign. In developing the messaging, the project team will analyze the benefits which receivers of the information will gain from changing their purchasing behavior, as well as the identifying the obstacles to the change. The messaging will use the branding of the certification logo, and be appropriate for the target group(s). Content development could include developing television clips or shows, the texts of SMS messages, graphic design of billboards, as well as clarifying the style and initial posts for social media and/or articles for social media.

8.3 Launch the educational marketing campaign using various media channels, and monitor, evaluate and improve on an ongoing basis.

Before full launch, the 3ADI+ platform will pilot the campaign by testing the messaging on focus groups, or with a narrowly defined target group, such as in one of the target territories. Data will be collected on the media channels to which people were the most receptive and which had the most impact, as well as on the receptiveness of people to the messaging and on any perceived behavior changes. The data will be used to improve the structure and content of the campaign, before a full launch. At that point, the full campaign will be executed using the developed content through the defined channels. The campaign will be monitored on a continual basis, with data collected and evaluated to constantly refine the targeting and messaging. After launch, the campaign will run periodically during the implementation period, with regular monitoring and evaluation of impact.

Output 9 (Ongoing support and M&E): Ongoing support is provided to the actors in the value chain, and the results of the intervention are monitored and evaluated.

9.1 Provide support and troubleshooting to project beneficiaries and organizations developed in the course of the project, to ensure sustainability. Once the 3ADI+ platform has engaged with an individual or organization to upgrade, the partners will continue to provide support, until the beneficiary has sufficiently adopted the new capacities and techniques to operate sustainably using the improved practices. Representatives of the 3ADI+ member institutions, or consultants hired by them, will monitor the beneficiaries and support them in resolving and overcoming any of the challenges that will inevitably arise when launching a new venture or upgrading to a new method of operations. Regular monitoring visits will be conducted to discuss challenges and achievements with beneficiaries from each of the outputs. Support will be provided both to the core value chain actors involved in the project, as well as to the institutions and service providers implementing the systemic interventions. While support will be provided throughout the duration of the project, the fifth and final year of the project is largely allocated for supporting activities only. This will ensure than few, or new, new initiatives will be implemented in the fifth year, but that the bulk of implementation will be completed by year four. Thus, all value chain and

business upgrades will be accompanied for at least one full year of troubleshooting support before the conclusion of the project.

9.2 Monitor and evaluate the impact of 3ADI+ interventions in the value chains to track socio-economic and other indicators. In addition to monitoring the progress of project implementation, and monitoring the achievement or challenges of the supported individuals, businesses and organizations, in adopting the upgrading support provided by the program, 3ADI+ will undertake a rigorous M&E (monitoring and evaluation) tracking of the impact of the program on beneficiaries. The M&E approach will involve tracking the financial results of beneficiaries, including collecting and analyzing revenues and costs, as they change as a result of participation in the program. In addition to tracking these purely quantitative results, M&E surveys and discussion groups will be used to evaluate impacts on family expenditures, issues of equality and inclusion within households and value chain segments, and environmental impacts.

5.3 Logframe

Table 52: 3ADI+ logframe

Overall impact: Develop sustainable dairy and beef value chains in Bangladesh	
Output 1	**The 3ADI+ stakeholder platform is formed with the roles of partner institutions defined; the geographical scope and territories for implementation are defined; and, pilot business models/interventions are implemented and evaluated**
Activity 1.1 Identify partners and 3ADI+ platform members, and develop MOUs/contracts to define roles Activity 1.2 Identify the geographical scope of implementation and select target territories. Activity 1.3 Implement and monitor pilot projects, and conduct evaluation.	
Output 2	**Cattle farmers are organized and practices improved, with farmers working through registered associations/cooperatives to achieve increased milk production quantity and quality, self-monitoring of animal health, and participation in the feed-for-milk scheme of the PPP milk collection hubs**
Activity 2.1 Develop and implement a methodology to select farmer beneficiaries. Activity 2.2 Create or revitalize farmer associations and/or cooperatives Activity 2.3 Facilitate the delivery of capacity building and services, with monitoring and support to farmers. Activity 2.4 Reinforce the functionality of the associations to monitor the health status of members' cattle. Activity 2.5 Facilitate the linking of farmer associations and cooperatives to the feed-for-milk scheme of the PPP milk collection hub. Activity 2.6 Federate the producer associations, and link them with other farmer organizations at a national scale, and enhance their ability to influence trade relationships and policy making.	
Output 3	**Milk collection system expanded in proximity to farmers to supply the PPP milk collection hubs, and/or the industrial dairy processors.**
Activity 3.1 Develop and implement a methodology to select milk collection entrepreneurs/cooperatives. Activity 3.2 Support entrepreneurs/cooperatives to develop bankable business plans and to secure financing. Activity 3.3 Support entrepreneurs/cooperatives to secure land and construct/renovate facilities. Activity 3.4 Procure and set-up chilling equipment and milk testing laboratories using a matching grant facility, and capacitate entrepreneurs/cooperatives in the technical use of equipment. Activity 3.5 Train entrepreneurs on milk quality issues and support them to launch and expand business operations. Activity 3.6 Milk collector associations formed and expanded, with their capacities to influence trade relationships and policy making enhanced.	
Output 4	**Milk collection hubs, with pasteurization capacity, operated as Public Private Partnerships, launched and collect milk, to sell nationally.**
Activity 4.1 Select locations for hubs and local governments allocate land	

Activity 4.2 Develop business plans for specific hub locations. Activity 4.3 Support local governments to adapt designs and construct the infrastructure for the hubs. Activity 4.4 Support local governments to procure and set-up chilling and processing equipment, and milk testing laboratories. Activity 4.5 Launch and award tender for management company of hub, and capacitate staff in the use of technical equipment. Activity 4.6 Support implementation of feed-for-milk scheme, and milk collection & processing. Activity 4.7 Coordinate cluster services, including MFIs to open offices in hubs.	
Output 5	**Processing methods of traditional dairy processors innovated and standardized, with producers producing safer products of higher value.**
Activity 5.1 Select institutions to host the traditional processor institutes, and sign MOUs/partnership agreements. Activity 5.2 Develop training curriculum, and support host institutions to develop business plans for institutes. Activity 5.3 Support host institutions to secure land, construct or confirm institute buildings, and equip the institutes. Activity 5.4 Support host institutions to staff the institutes; support instructor training, with outreach activities to processors/students launched; and support institutions to optimize institute operations as social businesses. Activity 5.5 Support host institutions to monitor and evaluate the result/impact of the training on processor business, and product quality in the value chain. Activity 5.6 Form and expand traditional processor associations, and capacitate them to influence trade relationships and policy making.	
Output 6	**Slaughter facilities upgraded and new facilities constructed to standardize processes and enable slaughters/butchers to comply with food safety standards.**
Activity 6.1 Select locations for slaughter facility renovation, upgrading and new construction, with planning confirmed with local governments and design options discussed with stakeholders. Activity 6.2 Renovate, construct, equip facilities and laboratories, and provide meat distribution vehicles. Activity 6.3 Train slaughters/butchers on safe/hygienic methods of slaughtering and butchering, and on how to use the improved machines and facilities. Activity 6.4 Support stakeholders (local governments, facility/market management committees, butchers) to implement usage of the new facilities, and undertake monitoring and evaluation of safer practices.	
Output 7	**Food safety and traceability certification agency developed as social business, to reinforce food safety good practices among beneficiaries and beyond.**
Activity 7.1 Select/verify agency which will operate the certification and traceability social business initiative, and develop business plan. Activity 7.2 Develop certification criteria harmonized with Bangladeshi standards, and training curriculum for different value chain segments. Activity 7.3 Develop the traceability system focusing on the dairy and beef value chains, including set-up, monitoring and auditing methodologies. Activity 7.4 Develop the communication methods of the certification, including the logo, and outreach methods. Activity 7.5 Launch the certification social business within the food safety authority, train staff on methodologies, and undertake operationalization. Activity 7.6 Evaluate the impact of the certifications on project beneficiaries, consumers and other stakeholders, and expand the reach of the certification system.	
Output 8	**Social marketing campaign implemented, educating consumers of traditional dairy products and fresh beef about food safety and nutrition, expanding demand for safe food products.**

Activity 8.1 Determine geographical and segment targeting of educational campaign, and select traditional and social media channels to use. Activity 8.2 Develop the messaging and content of the advertising campaign, highlighting certification logo. Activity 8.3 Launch educational marketing campaign launched using various media channels, and monitor, evaluate and improve on an ongoing basis.	
Output 9	**Ongoing support is provided to the actors in the value chain, and the results of the intervention are monitored and evaluated.**
Activity 9.1 Provide support and troubleshooting to project beneficiaries and organizations developed in the course of the project, to ensure sustainability. Activity 9.2 Monitor and evaluate the impact of 3ADI+ interventions in the value chains to track socio-economic and other indicators.	

5.4 Timeline

The implementation plan which follows proposes a timeframe for the implementation of the activities described in the previous section, called Concrete actions.

Table 53: 3ADI+ proposed program implementation plan

Outputs and Activities		**Timeframe**				
		Yr 1	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**
Output 1 (Strategic planning and piloting): The 3ADI+ stakeholder platform is formed with the roles of partner institutions defined; the geographical scope and territories for implementation are defined; and, pilot business models/interventions are implemented and evaluated.						
1.1	Identify partners and 3ADI+ platform members, and develop MOUs/contracts to define roles.					
1.2	Identify the geographical scope of implementation and select target territories.					
1.3	Implement and monitor pilot projects, and conduct evaluation.					
Output 2 (Primary production): Cattle farmers are organized and practices improved, with farmers working through registered associations/cooperatives to achieve increased milk production quantity and quality, self-monitoring of animal health, and participation in the feed-for-milk scheme of the PPP milk collection hubs.						
2.1	Develop and implement a methodology to select farmer beneficiaries.					
2.2	Create or revitalize farmer associations and/or cooperatives.					
2.3	Facilitate the delivery of capacity building and services, with monitoring and support to farmers.					
2.4	Reinforce the functionality of the associations to monitor the health status of members' cattle.					
2.5	Facilitate the linking of farmer associations and cooperatives to the feed-for-milk scheme of the PPP milk collection hub.					

2.6	Federate the producer associations, and link them with other farmer organizations at a national scale, and enhance their ability to influence trade relationships and policy making.					
Output 3: (Aggregation): Milk collection system expanded in proximity to farmers to supply the PPP milk collection hubs, and/or the industrial dairy processors.						
3.1	Develop and implement a methodology to select milk collection entrepreneurs/cooperatives.					
3.2	Support entrepreneurs/cooperatives to develop bankable business plans and to secure financing.					
3.3	Support entrepreneurs/cooperatives to secure land and construct/renovate facilities.					
3.4	Procure and set-up chilling equipment and milk testing laboratories using a matching grant facility, and capacitate entrepreneurs/cooperatives in the technical use of equipment.					
3.5	Train entrepreneurs on milk quality issues and support them to launch and expand business operations.					
3.6	Milk collector associations formed and expanded, with their capacities to influence trade relationships and policy making enhanced.					
Output 4 (Aggregation and processing): Milk collection hubs, with pasteurization capacity, operated as Public Private Partnerships, launched and collect milk, to sell nationally.						
4.1	Select locations for hubs and local governments allocate land.					
4.2	Develop business plans for specific hub locations.					
4.3	Support local governments to adapt designs and construct the infrastructure for the hubs.					
4.4	Support local governments to procure and set-up chilling and processing equipment, and milk testing laboratories.					
4.5	Launch and award tender for management company of hub, and capacitate staff in the use of technical equipment.					
4.6	Support implementation of feed-for-milk scheme, and milk collection & processing.					
4.7	Coordinate cluster services, including MFIs to open offices in hubs.					
Output 5 (Traditional dairy processing): Processing methods of traditional dairy processors innovated and standardized, with producers producing safer products of higher value.						
5.1	Select institutions to host the traditional processor institutes, and sign MOUs/partnership agreements.					
5.2	Develop training curriculum, and support host institutions to develop business plans for institutes.					
5.3	Support host institutions to secure land, construct or confirm institute buildings, and equip the institutes.					

5.4	Support host institutions to staff the institutes; support instructor training, with outreach activities to processors/students launched; and support institutions to optimize institute operations as social businesses.					
5.5	Support host institutions to monitor and evaluate the result/impact of the training on processor business, and product quality in the value chain.					
5.6	Form and expand traditional processor associations, and capacitate them to influence trade relationships and policy making.					
Output 6 (Slaughtering/beef processing): Slaughter facilities upgraded and new facilities constructed to standardize processes and enable slaughters/butchers to comply with food safety standards.						
6.1	Select locations for slaughter facility renovation, upgrading and new construction, with planning confirmed with local governments and design options discussed with stakeholders.					
6.2	Renovate, construct, equip facilities and laboratories, and provide meat distribution vehicles.					
6.3	Train slaughters/butchers on safe/hygienic methods of slaughtering and butchering, and on how to use the improved machines and facilities.					
6.4	Support stakeholders (local governments, facility/market management committees, butchers) to implement usage of the new facilities, and undertake monitoring and evaluation of safer practices.					
Output 7 (Food safety and traceability): Food safety and traceability certification agency developed as social business, to reinforce food safety good practices among beneficiaries and beyond.						
7.1	Select/verify agency which will operate the certification and traceability social business initiative, and develop business plan.					
7.2	Develop certification criteria harmonized with Bangladeshi standards, and training curriculum for different value chain segments.					
7.3	Develop the traceability system focusing on the dairy and beef value chains, including set-up, monitoring and auditing methodologies.					
7.4	Develop the communication methods of the certification, including the logo, and outreach methods.					
7.5	Launch the certification social business within the food safety authority, train staff on methodologies, and undertake operationalization.					

7.6	Evaluate the impact of the certifications on project beneficiaries, consumers and other stakeholders, and expand the reach of the certification system.					
Output 8 (Educational marketing campaign): Social marketing campaign implemented, educating consumers of traditional dairy products and fresh beef about food safety and nutrition, expanding demand for safe food products.						
8.1	Determine geographical and segment targeting of educational campaign, and select traditional and social media channels to use.					
8.2	Develop the messaging and content of the advertising campaign, highlighting certification logo.					
8.3	Launch educational marketing campaign launched using various media channels, and monitor, evaluate and improve on an ongoing basis.					
Output 9 (Ongoing support and M&E): Ongoing support is provided to the actors in the value chain, and the results of the intervention are monitored and evaluated.						
9.1	Provide support and troubleshooting to project beneficiaries and organizations developed in the course of the project, to ensure sustainability.					
9.2	Monitor and evaluate the impact of 3ADI+ interventions in the value chains to track socio-economic and other indicators.					

5.5 Risks

Table 54: Potential risks to the 3ADI+ programme

Risk identified	Risk Classification	Risk Description in the project	Mitigation Action (s)
Lack of coordination among different stakeholder groups	M	Weak coordination may cause delays for the implementation progress	The project should ensure clear and prompt communications with implementation partners
Inadequate commitment from local authorities	L	This will constrain the upgrading activities	Ensure continuous engagement with government and work with government focal point to coordinate with local authorities
Certain VC actors might be reluctant to changes	L	This will largely affect the adoption of certain technologies or upgrading practices.	Understand local traditions and culture before implementation, using pilot demonstration to dispel their concerns
Insufficient data collection for pilot identification, monitoring and evaluation	M	This will hinder the overall implementation process and adaptation strategies	Record keeping system Well coordinate with actors involved to collect reliable information Work with experienced researchers and experts

5.6 Budget plan

The budget below shows the roughly estimated costs per activity. As described, the concept of a stakeholder platform is used, involving a group of institutions, which join together to further develop and implement the project. The institutions are represented by individuals who make up the stakeholder platform leadership committee (or steering committee). Each of the different Outputs will have a lead organization – one of the platform members – which will be responsible for the implementation of the Output. During the implementation, other platform members may be involved in the execution process, and a significant amount of sharing and integration is envisioned between the actors during the implementation of the different Outputs. A single platform partner institution many hold overall responsibility for the implementation of more than one Output, while other platform partners may participate in the implementation, without having leadership responsibility for any single Output.

The budget for program implementation would be allocated by a multinational institution funding partner, and complimented by contributions from the stakeholder partners – including both financial and in-kind contributions of time and expertise. Other aspects of the budget would be contributed by private sector organizations, who are also among the beneficiaries of the project. The budget includes of these types of costs.

In the table below, the column on "coordination and meetings" represents monies to fund the operations of the stakeholder platform members, in implementing and/or coordinating the correlated activities. The "training, subcontracting and consulting" column, involves funds designated for building the capacity of actors through business and technical trainings, as well as subcontracting and consulting provided primarily by local organizations and consultants – generally not platform members – to implement specific activities (such as business plan development, support in forming and registering associations, or support in monitoring and trouble-shooting operational challenges with the beneficiary businesses. The columns "investments in equipment and technology" and "investments in land and civil works" divide the capital investments required to establish and launch the related value chain business into these two categories.

As a note to the investment columns, for the establishment of VMCCs, the entrepreneurs will generally be responsible for investments in land and civil works (Activity 3.3), while investments in equipment and technology could be shared on a co-financing basis. The funds shown for this investments (Activity 3.4) estimate the total funds required, which could be divided through a co-financing mechanism or provided from the budget for the program. In Output 4, the establishment and operation of the PPP milk collection hubs, all investment costs would generally come from the program budget, with the exception of funds negotiated to be contributed by local governments or private sector company partners – depending on the model of implementation as described in the Upgrading Opportunities section. In the case of upgrading/constructing slaughter facilities, the costs of the equipment upgrades have been included, with the associated infrastructure upgrades included in this column. The land and basic structures would already be owned by the local governments.

Table 55: 3ADI+ program proposed program budget

Outputs and Activities	Budget (USD)				
	Coord-ination, meetings	Training, sub-contracts, consulting	Invest-ments in equipment & technology	Invest-ments in land & civil works	Total
Output 1: Strategic planning and piloting	**70,000**	**62,286**	**314,941**	**12,000**	**447,227**

1.1	Identify partners and 3ADI+ platform members, and develop MOUs/contracts to define roles.	20,000				20,000
1.2	Identify the geographical scope of implementation and select target territories.	20,000				20,000
1.3	Implement and monitor pilot projects, and conduct evaluation.	30,000	62,286	314,941	12,000	407,227
Output 2: Primary production		**240,000**	**3,067,500**	**1,500,000**	**0**	**4,807,500**
2.1	Develop and implement a methodology to select farmer beneficiaries.	20,000				20,000
2.2	Create or revitalize farmer associations and/or cooperatives.	20,000	37,500			57,500
2.3	Facilitate the delivery of capacity building and services, with monitoring and support to farmers.	20,000	3,000,000	1,500,000		4,520,000
2.4	Reinforce the functionality of the associations to monitor the health status of members' cattle.	75,000				75,000
2.5	Facilitate the linking of farmer associations and cooperatives to the feed-for-milk scheme of the PPP milk collection hub.	75,000				75,000
2.6	Federate the producer associations, and link them with other farmer organizations at a national scale, and enhance their ability to influence trade relationships and policy making.	30,000	30,000			60,000
Output 3: Aggregation, VMCCs		**90,000**	**253,750**	**2,674,564**	**300,000**	**3,018,314**
3.1	Develop and implement a methodology to select milk collection entrepreneurs/cooperatives.	10,000				10,000
3.2	Support entrepreneurs/cooperatives to develop bankable business plans and to secure financing.	20,000	150,000			170,000
3.3	Support entrepreneurs/cooperatives to secure land and construct/renovate facilities.	10,000			300,000	10,000
3.4	Procure and set-up chilling equipment and milk testing laboratories using a matching grant facility, and capacitate entrepreneurs/cooperatives in the technical use of equipment.	20,000	18,750	2,674,564		2,713,314
3.5	Train entrepreneurs on milk quality issues and support them to launch and expand business operations.	20,000	75,000			95,000
3.6	Milk collector associations formed and expanded, with their capacities to influence trade relationships and policy making enhanced.	10,000	10,000			20,000
Output 4: Aggregation & processing		**111,500**	**85,000**	**7,477,850**	**6,305,691**	**7,674,350**
4.1	Select locations for hubs and local governments allocate land.	10,000				10,000
4.2	Develop business plans for specific hub locations.	20,000	25,000			45,000

4.3	Support local governments to adapt designs and construct the infrastructure for the hubs.	10,000	25,000		6,305,691	35,000
4.4	Support local governments to procure and set-up chilling and processing equipment, and milk testing laboratories.	12,500	25,000	7,477,850		7,515,350
4.5	Launch and award tender for management company of hub, and capacitate staff in the use of technical equipment.	12,500				12,500
4.6	Support implementation of feed-for-milk scheme, and milk collection & processing.	36,500				36,500
4.7	Coordinate cluster services, including MFIs to open offices in hubs	10,000	10,000			20,000
Output 5: Traditional dairy processing		**120,000**	**160,000**	**233,810**	**700,000**	**513,810**
5.1	Select institutions to host the traditional processor institutes, and sign MOUs/partnership agreements.	20,000				20,000
5.2	Develop training curriculum, and support host institutions to develop business plans for institutes.	20,000	50,000			70,000
5.3	Support host institutions to secure land, construct or confirm institute buildings, and equip the institutes.	20,000		233,810	700,000	253,810
5.4	Support host institutions to staff the institutes; support instructor training, with outreach activities to processors/students launched; and support institutions to optimize institute operations as social businesses.	20,000	50,000			70,000
5.5	Support host institutions to monitor and evaluate the result/impact of the training on processor business, and product quality in the value chain.	20,000	50,000			70,000
5.6	Form and expand traditional processor associations, and capacitate them to influence trade relationships and policy making.	20,000	10,000			30,000
Output 6: Slaughtering/butchering		**160,000**	**40,729**	**3,814,000**	**0**	**4,014,729**
6.1	Select locations for slaughter facility renovation, upgrading and new construction, with planning confirmed with local governments and design options discussed with stakeholders.	60,000				60,000
6.2	Renovate, construct, equip facilities and laboratories, and provide meat distribution vehicles.	30,000		3,814,000		3,844,000
6.3	Train slaughters/butchers on safe/hygienic methods of slaughtering and butchering, and on how to use the improved machines and facilities.	10,000	40,729			50,729

6.4	Support stakeholders (local governments, facility/market management committees, butchers) to implement usage of the new facilities, and undertake monitoring and evaluation of safer practices.	60,000				60,000
Output 7: Food safety & traceability		**493,917**	**70,000**	**0**	**0**	**563,917**
7.1	Select/verify agency which will operate the certification and traceability social business initiative, and develop business plan.	10,000				10,000
7.2	Develop certification criteria harmonized with Bangladeshi standards, and training curriculum for different value chain segments.	20,000	25,000			45,000
7.3	Develop the traceability system focusing on the dairy and beef value chains, including set-up, monitoring and auditing methodologies.	20,000	25,000			45,000
7.4	Develop the communication methods of the certification, including the logo, and outreach methods.	10,000	20,000			30,000
7.5	Launch the certification social business within the food safety authority, train staff on methodologies, and undertake operationalization.	413,917				413,917
7.6	Evaluate the impact of the certifications on project beneficiaries, consumers and other stakeholders, and expand the reach of the certification system.	20,000				20,000
Output 8: Educational marketing		**50,000**	**175,000**	**0**	**0**	**225,000**
8.1	Determine geographical and segment targeting of educational campaign, and select traditional and social media channels to use.	10,000	10,000			20,000
8.2	Develop the messaging and content of the advertising campaign, highlighting certification logo.	20,000	70,000			90,000
8.3	Launch educational marketing campaign launched using various media channels, and monitor, evaluate and improve on an ongoing basis.	20,000	95,000			115,000
Output 9: Ongoing support and M&E		**100,000**	**246,458**	**0**	**0**	**346,458**
9.1	Provide support and troubleshooting to project beneficiaries and organizations developed in the course of the project, to ensure sustainability.	50,000	123,229			173,229
9.2	Monitor and evaluate the impact of 3ADI+ interventions in the value chains to track socio-economic and other indicators.	50,000	123,229			173,229
GRAND TOTALS		**1,641,917**	**3,914,266**	**16,015,164**	**7,317,691**	**21,571,347**

The budget figures for Activity 3.1, to implement and monitor pilot projects, and conduct evaluation, are broken down in the table below, which shows the number of pilot projects expected for each value chain segment.

Table 56: Budget breakdown for Activity 3.1 – pilot projects and evaluation

Activity 1.3 – pilots	Number of pilots	Training, subcontracting, consulting	Investments in equip & technology	Investments in land & civil works
Farmer associations	5	20,250	10,000	
VMCCs	3	3,000	106,983	12,000
Traditional processors	5	5,000	7,258	
Slaughter houses	3	2,036	190,700	
M&E	16	32,000		

5.7 Stakeholder platform member institutions

Leading organizations: FAO and UNIDO

List of partners and stakeholders that would potentially become members of the stakeholder platform:

- DLS
- Farmer groups/cooperatives (milk and meat)
- Bangladesh Agriculture University
- BLRI
- City Corporation
- Bangladesh Food Safety Authority
- SMEs
- Bangladesh Meat Trader Association
- Sweetmeat associations (if any)
- Private companies (dairy and meat)

5.8 M&E

Monitoring will mainly focus on the management and supervision of programme activities, seeking to improve efficiency and overall effectiveness of programme implementation. The programme will be evaluated on its poverty reduction impacts. Evaluation of the programme's success in achieving its objectives and outcomes will be monitored continuously throughout the project. Therefore, the M&E work will include the following aspects:

1) Quarterly and annual progress reports: monitoring the actual activities at upazila, district and national level, compared to those scheduled in the action plan, based on the indicators as contained in the results measurement framework. Then recommend any essential adjustments that may be required.
2) The M & E should consist of information collection, including interviews and surveys to examine the satisfaction of key value chain actors and the effectiveness of the programme implementation.

In the concluding phase of the programme, a final report will be made to assess the activities have been implemented, and the achievements of the expected outcomes, outputs and impacts. The final evaluation will be reported to programme stakeholders, beneficiaries and all partners involved.

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Annex 1 Margin analysis

I) Dairy value chain actors

Profit margin of milk producers (by types)

	Local breed farming system	Crossbreed :Local x HF (62.5%)	Crossbreed: Shaiwal x Local
Annual revenues	**38,280**	**111,857**	**67,272**
Number of local breed	1	1	1
Liters of milk produced (liter/year)	270	1,960	945
Price (average of high and lean season)	39	39	39
Cash revenue from milk (BDT/year)	10,530	76,440	36,855
Other revenues (dung sale/calf sale) (BDT/year)	27,750	35,417	30,417
Total annual expenses	**22,573**	**86,355**	**58,810**
Cost of feeding	18,923	74,955	53,010
Cost of production	3,650	11,400	5,800
Profit			
Profitability of milk sales	-12,403	-9,915	-21,955
Profit margin (for milk only)	-114.4%	-13%	-59.6%

Profit margin of milk collectors (average by districts)

	Annual revenues from milk sales (,000 BDT)	Total expenses(,000 BDT)	Profitability(,000 BDT)	Profit margin
Feni	1,890	1,527.2	362.8	19.2%
Chittagong	3,240	2,675.8	564.2	17.41%
Tangail	12,150	11,599.2	550.8	4.53%
Dinajpur	4,464	4,723.5	-259.5	-5.81%
Satkhira	12,556.8	12,052.6	504.2	4.02%
Kushtia	2,217.6	1,789.25	428.35	19.32%
Natore	2,052	1,890.07	161.93	7.89%
Pabna	14,688	13,698.4	989.6	6.74%

** Dinajpur: shift from milk to meat production, low profit margin for milk collection. Cittagong and Feni: urban cities with high profit margin

Profit margin of village milk collection centers

Annual revenues from milk sales (BDT)	Total expenses (BDT)	Profitability	Profit margin
28,458,000	1,870,302	1,759,698	6.18%

Profit margin of traditional processors (by districts)

	Annual revenue from sweetmeat sales (,000 BDT)	Total expenses (,000 BDT)	Profitability	Profit margin
Satkhira	7,830	5,612.04	2,217.96	28.33%
Kushtia	4,419	3,744	675	15.27%

Natore	8,632	4,919.07	3,713.73	43.02%
Feni	15,030	9,452.54	5,577.46	37.11%
Chittagong	9,468	8,227.96	1,240.04	13.10%
Sirajganj	9,199.8	5,705.5	3,494.3	37.98%
Kurigram	4,206.6	3,100.12	1,106.48	26.30%

** Natore and Sirajganj: milk zones

II) Beef value chain actors

Profit margin of bull fattening farmers (by types)

	Local breed farming system	Crossbreed :Local x HF
Annual revenues	**80,000**	**111,857**
Number of local breed	1	1
Sale of fattened bull (BDT)	80,000	100,000
Other revenues (dung sale)	0	0
Total annual expenses	**64,568.5**	**72,725**
Bull purchasing price	50,000	**52,000**
Cost of feeding	7,309.2	9,225
Cost of production	7259.3	11,500
Profit		
Profitability of bull sales	15,431.5	39,132
Profit margin (for milk only)	19.3%	35%

Profit margin of cattle traders (by districts)

	Annual revenues from cattle trade(,000 BDT)	Total expenses(,000 BDT)	Profitability(,000 BDT)	Profit margin	Profit margin (during Qurbani)
Tangail	13,016	12,237	779	5.98%	18.14%
Dinajpur	174,000	15,485	1,915	11.01%	15.1%
Satkhira	87,200	83,477.5	3,722.5	4.27%	8.75%
Kushtia	41,400	38,893.2	2,506.8	6.06%	31.01%
Natore	39,640	37,876.3	1,763.7	4.45%	4.44%
Kurigram	123,885	110,197.3	13,687.7	11.05%	3.47%
Feni	142,000	116,628	25,372	17.87%	15.25%
Chittagong	116,850	109,951	6,899	5.9%	6.97%

Profit margin of butchers/slaughters (by districts)

	Annual revenues from butchering retail sales(,000 BDT)	Total expenses(,000 BDK)	Profitability(,000 BDK)	Profit margin
Tangail	102,232.8	59,756	42,476.8	41.55%
Dinajpur	25,783.2	21,830.6	3,952.6	15.33%
Satkhira	23,616	18,233.6	5,382.4	22.79%
Dhaka	18,525.6	17,228	1,297.6	7.64%
Kushtia	18,612	14,536.1	4,075.9	21.9%

Natore	16,923.6	16,380.6	543	3.21%
Chittagong	48,060	38,294.2	9,765.8	20.32%
Feni	23,832	25,819.2	-1,987.2	-8.34%
Kurigram	17,424	17,170.7	253.3	1.45%
Sirajganj	14,724	15,577.8	-853.8	-5.8%

** High profit margin in peri-urban and urban areas

Profit margin of hide collectors (by districts)

	Annual revenues from sales of hides(,000 BDT)	Total expenses(,000 BDK)	Profitability(,000 BDK)	Profit margin
Dinajpur	14,256	8,405	5,851	41.04%
Tangail	10,800	8,694	2,106	19.5%

** Dinajpur: meat zone. Tangail: peri-urban (supply to tanneries near Dhaka)

Profit margin of bone collectors (average)

Annual revenue from sales of bones(BDT)	Total expenses(BDT)	Profitability(BDT)	Profit margin
125,955	81,480	44,475	35.31%

Annex 2 Capital cost of the PPP hub model

Land Acquisition Cost

	Rate in USD	Price in USD	Price in BDT
Land rate atSirajganj district in Bangladesh: Per "*Decimal*" (435.6 ft^2 or 40.47m^2)	654.80- 773.81 (per 40.47 $m^2$of land area)		
Dairy Hub total Area (22628 m^2) purchase cost	700 USD / 40.47m^2	391391	32,876,844
Land Registration & Other	- 10% of the land value as fee + - 50000 BDT (595 USD) for other registration paper charges	39734	3,337,656
	TOTAL	**431125**	36,214,500

Exchange rate: 1 USD = 84 BDT

Site development & civil works cost

SL.NO	DESCRIPTION OF WORK	QTY.	UNIT	UNIT PRICE IN USD	TOTAL IN USD (Option-1)	TOTAL IN USD (Option-2) (Economical version)
A	**Site Preparation**					
Option-1 (quality version)	i. Earth cutting, sand back filling, leveling etc.	1	lump sum	41716	41716	
Option-2 (economical version)	If the proposed project land is road level or high-low variation up to 200-300 mm	1	lump sum	29866.65		29866.65
B	**Road Making**					
Option-1 (quality version)	12m and 6m wide bituminous carpeting road (earth work, surface dressing to camber, one layer herring bone bond brick, brick on end edging, bituminous carpeting 100mm, 12mm thick seal coat and binding the surface with sand)	5544	m^2	152	491179.3	
Option-2 (economical version)	Over all 6m wide Earth work, surface dressing to camber, one layer brick soling and 6" R.C.C work with 12mm diameter deform bar as per designer and direction of consultant	3232	m^2	37.83		122276.7
C	**Main Plant building**					

	Processing unit					
I.	Wall +Floor					
Option-1	250mm brick wall with RCC column, 3m high inside wall tiles and floor tiles including all civil, glass alum and MS grill work up to painting works without shed.	1115	m^2	154.95	172769	
Option-2 (economical version)	125 & 250mm brick wall with RCC column, 3m high inside wall tiles and floor tiles including all civil, glass alum and MS grill work up to painting works without shed.	1115	m^2	141		157215
II.	Shed					
Option-1	Steel shed as per design (37mx50m)	1488	m^2	238.38	355453	
Option-2 (economical version)	Steel shed as per design (Truss making of 6x75x75mm MS angle for short span and industrial tin as per design and direction)	1488	m^2	115.42		167128.16
	Utility:					
I.	Wall +Floor					
Option-1	- Boiler, Generator, Substation and Ammonia plant purpose. - Low deep RCC foundation, 250x250mm column, 125mm brick wall, net cement finishing including all civil and painting works. - Without shed.	351	m^2	95.35	33468	
Option-2 (economical version)	None	351	m^2	95.35		33468
II.	Shed					
Option-1	Steel shed truss design by H/I bar for long span as per design	435	m^2	154.95	67401	
Option-2 (economical version)	Steel shed as per design (Truss making of 5x50x50mm MS angle for short span and industrial local tin as per design and direction)	435	m^2	102.60		44631
	Water treatment plant:					
I.	Wall +Floor					
Option-1	- 250mm brick wall and RCC UGWR with RCC column, including all civil and MS grill work up to painting works. - Without shed.	110	m^2	143.03	15733	
Option-2 (economical version)	None	110	m^2	143.03		15733

II.	Shed					
Option-1	Steel shed truss design by H/I bar for long span as per design	147	m^2	154.95	22777	
Option-2 (economical version)	Steel shed as per design (Truss making of 5x50x50mm MS angle for short span and industrial local tin as per design and direction)	147	m^2	102.60		15082.2
	CIP (Cleaning In Place):					
I.	Wall +Floor					
Option-1	250mm brick wall with RCC column, including all civil and MS grill work up to painting works without shed.	84	m^2	95.35	8009	
Option-2 (economical version)	Steel shed as per design (Truss making of 5x50x50mm MS angle for short span and industrial local tin as per design and direction)	84	m^2	102.60		8618.4
II.	Shed					
Option-1	Steel shed truss design by H/I bar for long span as per design	114	m^2	154.95	17663	
Option-2 (economical version)	Steel shed as per design (Truss making of 5x50x50mm MS angle for short span and industrial local tin as per design and direction)	114	m^2	102.60		11696.4
	ETP (Effluence Treatment Plant):					
I.	Complete (without shed)					
Option-1	250mm brick wall with RCC wall, including all civil and MS grill work up to painting works.	150	m^2	244	36600	
Option-2 (economical version)	Inside 125mm RCC wall and then outside 125mm brick wall, including all civil and MS grill work up to painting works.	150	m^2	154		23100
D	**Office Building**					
I.	2 storied Office Building(12mx15m)					
Option-1	2 storied office building RCC foundation with 125mm brick wall and RCC beam & column, 600x600 floor tiles (imported) including all civil, electrical, plumbing, glass alum. & grill works. All complete as per design and direction	396	m^2	256.26	101479	
Option-2 (economical version)	125mm brick wall with RCC beam & column, 600x600 floor tiles (local) including all civil, electrical, plumbing, glass alum. & grill works.	396	m^2	230.87		91424.52
E	**Guard Room and Fodder Retail Outlet**					
I.	Complete					

Option-1	Single storied Retail Sales building with Guard room RCC foundation (125mm brick wall with RCC beam & column, 600x600 floor tiles (imported) floor tiles including all civil, electrical, plumbing, glass alum. & grill works) all completed as per design and direction.	160	m^2	192.37	30779.50	
Option-2 (economical version)	Single storied Retail Sales building with Guard room RCC foundation (125mm brick wall with RCC beam & column, 600x600 floor tiles (local) floor tiles including all civil, electrical, plumbing, glass alum. & grill works) all completed as per design and direction.	160	m^2	173		27680
F	**Fodder Warehouse**					
I.	Floor + Wall					
	RCC shallow foundation, 250x250mm column, 125mm brick wall, net cement finishing including all civil and painting works without shed.	244	m^2	80	19520	19520
II.	Steel Shed					
	Steel shed as per design (Truss making of 5x50x50mm MS angle for short span and industrial local tin as per design and direction)	244	m^2	102.60	25034.4	25034.4
G	**Parking Purpose**					
I.	Complete					
Option-1 (with Shed)	Low deep foundation, Grade beam, Column, Tie beam and floor casting with 37.5x37.5 angle frame steel shed etc. as per design and direction.	450	m^2	113.23	50953	
Option-2 (economical version) (no Shed)	Parking area T-beam, herring bond brick soling and then pointing without any shed as per design and direction.	450	m^2	25		11250
H	**Boundary wall and gate**					
I.	Boundary Wall					
Option-1	Boundary wall made by 600x600mm @2.5m interval RCC foundation, 200x200 column 125mm brick wall and 75mm MS pipe all complete as per design and direction of consultant.	592	m	47.68	28226.56	

Option-2 (economical version)	Boundary wall made by 600x600mm @3m interval RCC foundation, 200x200 column 125mm brick wall all complete as per design and direction of consultant.	592	m	31.28		18837.44
II.	Gate					
Option-1	Making, fitting and fixing of mechanical sliding main gate with by MS bar and sheet complete with all accessories as per design and direction	2	No.	2384	4768	
Option-2 (economical version)	Making, fitting and fixing of sliding main gate with by MS bar and sheet complete with all accessories as per design and direction	2	No.	1787.85		3875.7
I	**Greenery & Landscape**					
Option-1	Green area according to landscape design.	13093	m^2	(Lumpsum)	5000	
Option-2 (economical version)	Green area by local sapling planting	13093	m^2	(Lumpsum)		3575.69
TOTAL (Option-1/standard quality version) (USD):					**1,528,528.76**	
TOTAL (Option-2/economical version) (USD):						**830,013.26**

Machineries Procurement & Setup Cost -- Raw Milk Reception Section

SL	DESCRIPTION	Brand/Origin	Unit price (USD)	QTY	TOTAL Price (USD)	TOTAL Price (BDT)
	RECEPTION SECTION					
1	Can Tip Bar (MS pipe and channel & fitted wooden block)	India/Local	80	1	80	6,720
2	SS Can (25 L)	India/Local	60	20	1200	100,800
3	Disc Filter	India	100	1	100	8,400
4	SS Can drip saver	India/Local	168	1	168	14,112
5	SS Milk Pump (sanitary centrifugal pump) (100L/Min)	India	210	1	210	17,640
6	Laboratory Equipment Sets (Microscope, Test tubes, beakers, reagents)	Local/Indian	800	1 set	800	67,200
7	Handheld Milk Analyzer - (measurement time: 5 sec.) - (Measures Fat, SNF, added water, density) - [Power: 220V and 12V (battery backup)]	Laktan 1-4 model 900- (India/Russia)	400	1	400	33,600
8	Dump tank	Local/Indian	2500	1	2500	210,000
Tax (7.5%)					589	49476
Shipping (estimated)(by Truck)					2000	16,800
				SUB-TOTAL (USD)	**8047**	**675,948**

Exchange rate: 1 USD = 84 BDT

Machineries Procurement & Setup Cost -- Vehicles

SL	DESCRIPTION	Brand	Price/unit (USD)	QTY	TOTAL Price (USD)	TOTAL Price (BDT)
I	**TRANSPORT**					
1	5 Ton capacity Tanker (double hulled, insulated, non-refrigerated)	Chinese/Indian	67000	1	67000	5,628,000
2	14 Ton capacity Tanker (double hulled, insulated, non-refrigerated)	Chinese/Indian	95488	1	95488	8,020,992
3	Utility Pickup Truck (1 ton)	Chinese/Indian	23827	2	47654	4,002,936
4	Covered VAN/Truck (5 ton)	Chinese/Indian	60000	1	60000	5,040,000
5	Covered VAN/Truck (1.5 ton)	Chinese/Indian	25000	2	50000	4,200,000
Tax (32.07%)					Included	
Shipping (estimated)					5000	420,000
			SUB-TOTAL (USD)		**325142**	**27,311,928**

Exchange rate: 1 USD = 84 BDT

Machineries procurement & Setup Cost -- processing, packaging & storage Section

SL	DESCRIPTION	Brand	Price/unit (USD)	QTY	TOTAL Price (USD)	TOTAL Price (BDT)
PROCESSING SECTION						
1	S.S.Delivery Milk Pump 2 H.P. (220v,1HP,Suction-1.5" Delivery-1.5",50Hz,2900RPM)	China	1000	3	3000	252,000
2	Deaerator (5000L/H)	China	6000	1	6000	504,000
3	S.S. Milk Chiller, (Cap. 3KLPH) (DeLaval)	USA	25000	2	100000	8,400,000
4	S.S. Milk tank (5000L) (non-chiller, with agitator)	Local/India	10000	2	20000	1,680,000
5	S.S. Milk tank (15000L) (non-chiller, with agitator)	Local/India	17000	1	17000	1,428,000
6	S.S Silo (50000 L)	China/India	20000	1	20000	1,680,000
7	Milk Pasteurizer (5000L per hour)	China	100000	1	100000	8,400,000
8	High Pressure Homogenizer (2000L per hour) (25 MPA)	China	35000	2	70000	5,880,000
9	Chilling Tank (5000L)	India/China	6000	2	12000	1,008,000
10	Centrifugal Separator & Standardization (5000L/H)	China	40000	1	40000	3,360,000
12	Interconnecting S.S. Pipeline & valves and sensors	China	Lump sum	1	60000	5,040,000
13	Production control & monitoring system	China	Lump sum	1	15000	1,260,000
14	Milk Clarifier/Filter	India/China	15000	1	15000	1,260,000
15	Transport cost of the equipment	India/China	Lump sum	1	20000	1,680,000
16	Equipment Installation & Commissioning	China/India/ Local	Lump sum	1	30000	2,520,000
STORAGE & PACKING SECTION						
1	Packaging (pouch type) (filling wrapping, sealing) machine (60 bag/min) (3.5 KW)	China	25000	2	50000	4,200,000
2	Cold storage with cooling unit (cooling capacity: (10 ton) (34 HP)	China/Thailand	70000	1	70000	5,880,000
ELECTRICALS						

1	Plant Electricity Wiring + Switches Sockets + Fuses + Lights + Installation& Commissioning	Local/China/ India	Lump sum	1	20000	1,680,000
Import Duty (7.5%)					50100	4,208,400
Shipping			Lump sum		24000	2,016,000
				SUB-TOTAL	**742100**	**62,336,400**

Exchange rate: 1 USD = 84 BDT

Machineries Procurement & Setup Cost -- Quality Control Section

SL	DESCRIPTION	Brand	Price/unit (USD)	QTY	TOTAL Price (USD)	TOTAL Price (BDT)
QUALITY CONTROL (Laboratory)						
1	Milk Analyzer - measuring parameters: [Fat, Solid-non-fat (SNF), Density, Protein, Lactose, Milk Sample Temperature, Added Water, Salts, Freezing point, Total Solid, pH (Option), Conductivity (Option), Lon meter (option)]	**LACTOSCAN- SL** (India)	800	2	1600	134,400
2	Handheld Milk Analyzer - (measurement time: 5 sec.) - (Measures Fat, SNF, added water, and density) - [Power: 220V and 12V (battery backup)]	Laktan 1-4 model 900- (India/Russia)	400	1	400	33,600
3	Electronic Balance (upto 1 kg)	India	100	1	100	8,400
4	Lactometer (handheld manual added water/density test)	India	2	4	8	672
5	Handheld PH meter	India	60	1	60	5,040
6	Microscope	China	500	1	500	42,000
7	Milk Adulteration Testing Kit (Detection of additives in milk)	India	47	10	4700	394,800
8	Lab Desk	Local	Lump sum	1	2000	168,000
9	Lab Chair	Local	100	4	400	33,600
10	Lab Computer Desktop + Laser Printer	Local	1200	1	1200	100,800
11	Various reagents	India	Lump sum	1	500	42,000
Import Duty (26.27%)					207	17,388
Shipping					1000	84,000
				SUB-TOTAL	**12675**	**1,064,700**

Exchange rate: 1 USD = 84 BDT

Machineries Procurement & Setup Cost -- Office & Retail store setup cost

SL	DESCRIPTION	Brand	Price/unit (USD)	QTY	TOTAL Price (USD)	TOTAL Price (BDT)
OFFICE + RETAIL STORE (fodder)						
1	Desktop	Local (various sourced components)	715	10	7150	600,600
2	Monitor (22" size)	HP	95	10	995	83,580
3	Laser Printer with scanner	HP/Samsung	300	3	900	75,600
4	Chair	Local sourced	40	20	800	67,200

5	Desk	Local sourced	178	12	2136	179,424
6	Conference table	Local sourced	450	1	450	37,800
7	Office networking + Installation	Local sourced	Lump sum	500	500	42,000
8	Security Cameras (entire area)	Local sourced	Lump sum	2000	2000	168,000
9	Retail shop setup	Local sourced	Lump sum	3000	3000	252,000
10	Retail fodder + medicine	unknown	unknown	unknown	unknown	
Import Duty (locally sourced)					0	0
Transport					300	25,200
				SUB-TOTAL	**18231**	**1,531,404**

Exchange rate: 1 USD = 84 BDT

Machineries procurement & setup cost -- Utilities procurement &setup cost

SL	DESCRIPTION	Brand	Price/unit (USD)	QTY	TOTAL Price (USD)	TOTAL Price (BDT)
UTILITIES						
1	Boiler (for hot water & steam) - Oil & gas fired - Capacity: 7000 kg/hour (considering cumulative 25% system loss (boiler, piping etc.) - Working pressure: 15 kg/cm2g	Local	48000	1	48000	4,032,000
2	Water storage Tank & Valves	Local	15000	1	15000	1,260,000
3	WTP Plant (including filtration + softener) - capacity: 12000L/H	China	25000	1	25000	2,100,000
4	G.I. Pipeline, valves & water Pump	Local/India	Lump sum	1	30000	2,520,000
5	Deep Water submersible pump	Local	3000	1	3000	252,000
6	ETP Plant	Local/China	Lump sum (estimated)	1	40000	3,360,000
7	CIP (Cleaning In Place) system (water-acid-alkali)	China	20000	1	20000	1,680,000
8	Ammonia cooling plant - cooling capacity: 4000 kw - power consumption: 23 kw	China	60000	1	60000	5,040,000
9	Backup Electricity Generator (Diesel) (350 KVA, 250KW)	PERKINS (UK) Motor: Perkins (UK),Alternator: Stamford (USA)	45000	1	45000	3,780,000
10	High Voltage Transformer unit (500 kVA) (Transformer, PFI, etc.) + Cables + Meter + Change Over Switch + Installation& Commissioning	Energypac (Bangladesh)	50000	1	50000	4,200,000
11	Site Lighting	Local/Chinese	Lump sum	1	10000	840,000
12	Installation & Commissioning (by foreign experts)		Lump sum		25000	2,100,000
Import Duty (7.5%)					18375	1,543,500
				SUB-TOTAL	**389375**	**32,707,500**

Total Capital Cost

SL	Capital Cost (USD)	Option-1 (USD)	Option-1 (BDT)	Option-2 (USD)	Option-2 (BDT)
1	Land Acquisition Cost (estimated)	431,125	36,214,500	431125	36,214,500
2	Civil works & Infrastructure setup Cost	1,528,528.76	128,396,415.84	830,013.26	69,721,113.84
3	Total Machineries cost	1,495,570.00	125,879,880	1,495,570.00	125,627,880
4	Legal fees(see **Error! Reference source not found.** on page **Error! Bookmark not defined.**)	1675.58	140,748.72	1675.58	140,748.72
	TOTAL (Option-1)	**3,456,898.58**	**290,379,480.72**		
	TOTAL (Option-2)			**2,758,383.84**	**231,704,242.56**

NOTE: Option-1 and Option-2 are from the table "Site development & civil works cost**"**

Annex 3 Cost benefit analysis of fodder cultivation

NAPIER (Pennisetum purpureum): Cultivation (Cost Benefit Analysis)

Operation	Cost	Remark
Land preparation		
(a) Ploughing: minimum 15 days interval between the first and last ploughing to remove weeds; **1. By tractor:** 3-4 ploughings, 3-4 days interval between ploughings or **2. By power tiller:** 4-5 ploughings, 3-4 days interval between ploughings	4800/-	1.@ Tk.1200/acre;4 liters of diesel per acre @ Tk. 65.45/- 2. @ Tk.950/acre; 2.5 liters of diesel per acre @ Tk. 65.45/-
(b) Fertilizer application: after 3rd ploughing **1. Chemical fertilizer:** apply 20kg urea,25 kg TSP and 15 kg MoP per acre before last ploughing **2. Cow dung:**2-2.5 tons/acre	320+600+225+200=1345/- 2500+800= 3,300/-	1. (Urea (Jamuna) @ Tk. 800/50 Kg, TSP(Tunisia) @ Tk.1200/50 Kg &MoP (Canada)@ Tk. 750/50 Kg & ½ d Labor @ Tk. 400/Labor) (Cow dung@ Tk.1/Kg &2 Labor @Tk.400/Labor)
(c) Laddering: immediately after final ploughing	500/-	@ Tk.500/acre
(d) Herbicide application: **1. Neon:** Dilute 800g in 200 liters of water and spray between the rows 20-25 days after sowing; or, **2. Panida:** Dilute 800g in 200 litres of water and spray on the soil within 3 days of sowing; the soil should be moist (in dry soil the action of herbicide is limited; in that case spray should be applied meticulously)	840+100=940/-	1. Neon-@ Tk. 95/100ml 2.Panida-Tk. @ 105/100 ml (2 hours labor; @Tk. 400/Labor)
Sowing		
(a) Time: February-May		
(b) **Line sowing method/ Plantation:** Either stem or root of the grass can be used for this purpose. It stem is used; it should have at least two to three nodes.	400×6=2400/-	6 labors; @Tk.400/Labor

(c) Line space:70 cm & cutting to cutting 35 cm		
(d) Seed/Cutting: 10,000 cutting/acre or 400kg /acre	4×400=1600/-	1.@ Tk.4/Kg
Inter-cultural operation		
(a) Weeding: on 30-35th days removal of weeds between lines with small or khurpi	8×400=3200/-	8 labors; @ Tk.400/Labor
(b) Mild irrigation: During rainy season no irrigation is needed. In dry season frequent irrigation is needed.(In summer irrigation is given in every 15-20 days)	500 + 100=600/per irrigation, = (600×12)=7200/-	@ Tk.500/acre (2 hours labor; @ Tk. 400/Labor)
(c) Fertilizer application: @ 20kg Urea/acre, after 30% of cutting plantation & after every harvesting	320+100=420/- per cutting = (420 × 7)=2940/-	Urea (Jamuna) @ Tk. 800/50 Kg (2 hours Labor @Tk.400/Labor)
Harvesting		
Labors for harvesting & carrying (on an average 6 cutting per year) (In first year 5-6 times and 2nd year 6-8 times cutting)	10×400=4000/ per cutting = (4000×6)=24,000/-	10 labors; @Tk.400/Labor
Yield per acre: 70 tons/acre	-	Yield may vary depending on soil condition, climate, and variety of seed, season & many other factors.
Costing		
(a) 1. Total cost of cultivation per acre per year	52,225/-	Cost may vary depending on the availability & price of the determinates like seed, labor, fertilizer etc.

(b) Cost per kg grass	Tk. 0.746or 0.75/kg	It may varies from Tk.0.67-1.27/kg
(c) Income per acre per year:	1,05,000/-	@Tk.2/kg
Profit: 1,40,000-52,225=87,775/-**per acre per year**		

N.B.: Considering 1 Day Labor= 8 Hours Labor

GERMAN (Echinochloa polystachya): Cultivation (Cost Benefit Analysis)

Operation	Cost	Remark
Land preparation		
(a) Ploughing: minimum 15 days interval between the first and last ploughing to remove weeds; **1. By tractor:** 3-4 ploughings, 3-4 days interval between ploughings or **2. By power tiller:** 4-5 ploughings, 3-4 days interval between ploughings	4800/-	1.@ Tk.1200/acre;4 liters of diesel per acre @ Tk. 65.45/- 2. @ Tk.950/acre; 2.5 liters of diesel per acre @ Tk. 65.45/-
(b) Fertilizer application: after 3rd ploughing **1. Chemical fertilizer:** apply 20 kg urea, 25 kg TSP and 15 kg MoP per acre before last ploughing **2. Cow dung:** 2-2.5 tons/acre	320+600+225+200=1345/- 2000+800= 3,300/-	1. (Urea (Jamuna) @ Tk. 800/50 Kg, TSP(Tunisia) @ Tk.1200/50 Kg &MoP (Canada)@ Tk. 750/50 Kg & ½ d Labor @ Tk. 400/Labor) (Cow dung@ Tk.1/Kg & 2 Labor @Tk.400/Labor)
(c) Laddering: immediately after final ploughing	500/-	@ Tk.500/acre
(d) Herbicide application: **1. Neon:** Dilute 800g in 200 liters of water and spray between the rows 20-25 days after sowing; or, **2. Panida:** Dilute 800g in 200 litres of water and spray on the soil within 3 days of sowing; the soil should be moist (in dry soil the action of herbicide is limited; in that case spray should be applied meticulously)	840+100=940/-	1. Neon-@ Tk. 95/100ml 2.Panida-Tk. @ 105/100 ml (2 hours labor; @Tk. 400/Labor)
Sowing		

(a) Time: February-May		
(b) **Line sowing method/ Plantation:** Either stem or root of the grass can be used for this purpose. It stem is used; it should have at least two to three nodes.	400×6=2400/-	6 labors; @Tk.400/Labor
(c) Line space: 70 cm & cutting to cutting 35 cm		
(d) Seed/Cutting: 12,000 cutting/acre or 480kg /acre	4×480=1920/-	1.@ Tk.4/Kg
Inter-cultural operation		
(a) Weeding: on 30-35th days removal of weeds between lines with small or khurpi	8×400=3200/-	8 labors; @ Tk.400/Labor
(b) Mild irrigation: During rainy season no irrigation is needed. In dry season frequent irrigation is needed.(In summer irrigation is given in every 15-20 days)	500 + 100=600/per irrigation, = (600×12)=7200/-	@ Tk.500/acre (2 hours labor; @ Tk. 400/Labor)
(c) Fertilizer application: @ 20kg Urea/acre, after 30% of cutting plantation & after every harvesting	320+100=420/- per cutting = (420 × 7)=2940/-	Urea (Jamuna) @ Tk. 800/50 Kg (2 hours Labor @Tk.400/Labor)
Harvesting		
Labors for harvesting & carrying (on an average 8 cutting per year) (In first year 6-8 times and 2nd year 8-10 times cutting)	10×400=4000/ per cutting = (4000×8)=32,000/-	10 labors; @Tk.400/Labor
Yield per acre: 55 tons/acre	-	Yield may vary depending on soil condition, climate, and variety of seed, season &many other factors.
Costing		

(a) 1. Total cost of cultivation per acre per year	60,545/-	Cost may vary depending on the availability & price of the determinates like seed, labor, fertilizer etc.
(b) Cost per kg grass	Tk.1.101 or 1.10/kg	It may varies from Tk.0.67-1.37/kg
(c) Income per acre per year:	82,500/-	@Tk.2/kg
Profit:1,10,000-60,545=49,455/-**per acre per year**		

N.B.: Considering 1 Day Labor= 8 Hours Labor

JUMBO (Pennisetum purpureum): Cultivation (Cost Benefit Analysis)

Operation	Cost	Remark
Land preparation		
(a) Ploughing: minimum 15 days interval between the first and last ploughing to remove weeds; **1. By tractor:** 3-4 ploughings, 3-4 days interval between ploughings or **2. By power tiller:** 4-5 ploughings, 3-4 days interval between ploughings	4800/-	1.@ Tk.1200/acre;4 liters of diesel per acre @ Tk. 65.45/- 2. @ Tk.950/acre; 2.5 liters of diesel per acre @ Tk. 65.45/-
(b) Fertilizer application: after 3rd ploughing **1. Chemical fertilizer:** apply 20 kg urea, 25 kg TSP and 15 kg MoP per acre before last ploughing **2. Cow dung:** 2-2.5 tons/acre	320+600+225+ 200=1345/- 2000+800= 3,300/-	1. (Urea (Jamuna) @ Tk. 800/50 Kg, TSP(Tunisia) @ Tk.1200/50 Kg &MoP (Canada)@ Tk. 750/50 Kg & ½ d Labor @ Tk. 400/Labor) (Cow dung@ Tk.1/Kg & 2 Labor @Tk.400/Labor)
(c) Laddering: immediately after final ploughing	500/-	@ Tk.500/acre
(d) Herbicide application: **1. Neon:** Dilute 800g in 200 liters of water and spray between the rows 20-25 days after sowing;		1. Neon-@ Tk. 95/100ml 2.Panida-Tk. @ 105/100 ml

or, **2. Panida:** Dilute 800g in 200 litres of water and spray on the soil within 3 days of sowing; the soil should be moist (in dry soil the action of herbicide is limited; in that case spray should be applied meticulously)	840+100=940/-	(2 hours labor; @Tk. 400/Labor)
Sowing		
(a) Time: February-April		
(b) **Line sowing method/ Plantation:** Either stem or root of the grass can be used for this purpose. It stem is used; it should have at least two to three nodes.	400×6=2400/-	6 labors; @Tk.400/Labor
(c) Line space: 70 cm & cutting to cutting 35 cm		
(d) Seed/Cutting: 12,000 cutting/acre or 480kg /acre	4×480=1920/-	1.@ Tk.4/Kg
Inter-cultural operation		
(a) Weeding: on 30-35th days removal of weeds between lines with small or khurpi	8×400=3200/-	8 labors; @ Tk.400/Labor
(b) Mild irrigation: During rainy season no irrigation is needed. In dry season frequent irrigation is needed.(In summer irrigation is given in every 15-20 days)	500 + 100=600/per irrigation, = (600×12)=7200 /-	@ Tk.500/acre (2 hours labor; @ Tk. 400/Labor)
(c) Fertilizer application: @ 20kg Urea/acre, after 30% of cutting plantation & after every harvesting	320+100=420/- per cutting = (420 × 7)=2940/-	Urea (Jamuna) @ Tk. 800/50 Kg (2 hours Labor @Tk.400/Labor)
Harvesting		

Labors for harvesting & carrying (on an average 7 cutting per year) (In first year 5-8 times and 2nd year 7-10 times cutting)	10×400=4000/ per cutting = (4000×7)=28,000/-	10 labors; @Tk.400/Labor
Yield per acre: 52 tons/acre	-	Yield may vary depending on soil condition, climate, and variety of seed, season &many other factors.
Costing		
(a) 1. Total cost of cultivation per acre per year	56,545/-	Cost may vary depending on the availability & price of the determinates like seed, labor, fertilizer etc.
(b) Cost per kg grass	Tk.1.087or 1.09/kg	It may varies from Tk.0.67-1.37/kg
(c) Income per acre per year:	78,000/-	@Tk.2/kg
Expected Profit:104000-56,545=47,455/-		

N.B.: Considering 1 Day Labor= 8 Hours Labor

MAIZE (Zea mays): CULTIVATION AND COSTING

Operation	Cost	Remark
Land preparation		
(a) Ploughing: the land should be dry; minimum 15 days interval between the first and last ploughing to remove weeds; **1. By tractor:** 3-4 ploughings, 3-4 days interval between ploughings or **2. By power tiller:** 4-5 ploughings, 3-4 days interval between ploughings	4800/-	1.@ Tk.1200/acre;4 liters of diesel per acre @ Tk. 65.45/- 2. @ Tk.950/acre; 2.5 liters of diesel per acre @ Tk. 65.45/-
(b) Fertilizer application: after 3rdploughing		1. (Urea (Jamuna) @ Tk. 800/50 Kg, TSP(Tunisia) @ Tk.1200/50

1. Chemical fertilizer: apply 20 kg urea, 25 kg TSP and 15 kg MoP per acre before last ploughing **2. Cow dung:** 9-10 tons/acre	320+600+225+200=1345/- 10000+3200= 13,200/-	Kg &MoP (Canada)@ Tk. 750/50 Kg & ½ d Labor @ Tk. 400/Labor) (Cow dung@ Tk.1/Kg & 8 Labor @Tk.400/Labor)
(c) Laddering: 3times immediately after final ploughing	1500/-	@ Tk.500/acre
(d) Herbicide application: **1. Neon:** Dilute 800g in 200 liters of water and spray between the rows 20-25 days after sowing; or, **2. Panida:** Dilute 800g in 200 litres of water and spray on the soil within 3 days of sowing; the soil should be moist (in dry soil the action of herbicide is limited; in that case spray should be applied meticulously)	840+100=940/-	1. Neon-@ Tk. 95/100ml 2.Panida-Tk. @ 105/100 ml (2 hours labor; @Tk. 400/Labor)
Sowing		
(a) Time: October-February		
(b) Line sowing method: sowing seeds in grooves made by cattle driven plough or tractor driven cultivator (9-prong), and then leveled with ladder	600+800=1400/-	b. @ Tk. 600/acre 2 labors; @Tk.400/Labor
(c) Line space:30 cm & seed to seed distance 5 cm		
(d) Seed: **1. Local variety:** 30-35 kg per acre **2. Hybrid:** 10-14 kg per acre; average 12 kg for fodder	12×350=4200/-	1.@ Tk.30/Kg 2.@ Tk.250-550/Kg
(e) Germination: 5-7 days	-	-
Inter-cultural operation		
(a) 1st weeding: on 20-25th days removal of weeds between lines with small or khurpi	8×400=3200/-	8 labors; @ Tk.400/Labor

(b) Mild irrigation: 2-3 days after 1st inter-cultural operation, when the soil becomes dry; the water will simply flow over the soil; if the water stagnates, then proper drainage is essential	500 + 100=600/-	@ Tk.500/Kg (2 hours labor; @ Tk. 400/Labor)
(c) After irrigation, allow the land to dry for 3-4 days, then apply 25kg Urea/acre	400+100=500/-	Urea (Jamuna) @ Tk. 800/50 Kg (2 hours Labor @Tk.400/Labor)
(d) 2nd weeding: on 40-45th days; 15-20 days after applying urea, and if needed	10×400=4000/-	10 labors; @ Tk.400/Labor
Harvesting		
Labors for harvesting & carrying	10×400=4000/-	10 labors; @Tk.400/Labor
Time: on 60-80 days	-	Time required will depends on type of variety, land, season, management etc.
Yield per acre: 26 tons/acre/season	-	Yield may vary depending on soil condition, climate, and variety of seed, season & many other factors.
Costing		
(a) 1. Total cost of cultivation per acre per season (3-3.5month)	39,685/-	Cost may vary depending on the availability & price of the determinates like seed, labor, fertilizer etc.
(b) Cost per kg grass	Tk. 1.526 or 1.53/kg	It may varies from Tk.0.87-1.67/kg
(c) Income per acre per season (3-3.5months):	52,000/-	@Tk.3.0/kg
Profit:78,000-39,685=38,315/- **per acre per season (3-3.5months)**		

N.B.: Considering 1 Day Labor= 8 Hours Labor

OAT (Avena sativa): CULTIVATION AND COSTING

Operation	Cost	Remark
Land preparation		
(a) Ploughing: the land should be dry; minimum 15 days interval between the first and last ploughing to remove weeds; **1. By tractor:** 3-4 ploughings, 3-4 days interval between ploughings or **2. By power tiller:** 4-5 ploughings, 3-4 days interval between ploughings	4800/-	1.@ Tk.1200/acre;4 liters of diesel per acre @ Tk. 65.45/- 2. @ Tk.950/acre; 2.5 liters of diesel per acre @ Tk. 65.45/-
(b) Fertilizer application: after 3rd ploughing **1. Chemical fertilizer:** apply 20 kg urea, 25 kg TSP and 15 kg MoP per acre before last ploughing **2. Cow dung:** 2-2.5 tons/acre	320+600+225 +200=1345/- 2500+800= 3,300/-	1. (Urea (Jamuna) @ Tk. 800/50 Kg, TSP(Tunisia) @ Tk.1200/50 Kg &MoP (Canada)@ Tk. 750/50 Kg & ½ d Labor @ Tk. 400/Labor) (Cow dung@ Tk.1/Kg & 2Labor @Tk.400/Labor)
(c) Laddering: 1 times immediately after final ploughing	500/-	@ Tk.500/acre
(d) Herbicide application: **1. Neon:** Dilute 800g in 200 liters of water and spray between the rows 20-25 days after sowing; or, **2. Panida:** Dilute 800g in 200 litres of water and spray on the soil within 3 days of sowing; the soil should be moist (in dry soil the action of herbicide is limited; in that case spray should be applied meticulously)	840+100=940 /-	1. Neon-@ Tk. 95/100ml 2.Panida-Tk. @ 105/100 ml (2 hours labor; @Tk. 400/Labor)
Sowing		
(a) Time: October-February		
(b) Seed sowing method: Broadcasting	800/-	2 labors; @Tk.400/Labor

(d) Seed: **1. Local variety:** 40-45 kg per acre **2. Hybrid:** 35-40 kg per acre;	 40×85=3400/-	 1.@ Tk.45/Kg 2.@ Tk.80-90/Kg
(e) Germination: 5-7 days	-	-
Inter-cultural operation		
(a) Weeding: on 30-35th days removal of weeds between lines with small or khurpi	8×400=3200/-	8 labors; @ Tk.400/Labor
(b) Mild irrigation: During rainy season no irrigation is needed. In dry season frequent irrigation is needed.(In summer irrigation is given in every 15-20 days)	500 + 100=600/per irrigation, = (600×4)=2400 /-	@ Tk.500/acre (2 hours labor; @ Tk. 400/Labor)
(c) Fertilizer application: @ 20kg Urea/acre, after 30 days of cutting plantation & after every harvesting	320+100=420 /- per cutting = (420 × 4)=1680/-	Urea (Jamuna) @ Tk. 800/50 Kg (2 hours Labor @Tk.400/Labor)
Harvesting		
Labors for harvesting & carrying (on an average 3 cutting per year)	10×400=4000 / per cutting = (4000×3)=12, 000/-	10 labors; @Tk.400/Labor
Yield per acre: 20 tons/acre	-	Yield may vary depending on soil condition, climate, and variety of seed, season & many other factors.
Costing		

(a) 1. Total cost of cultivation per acre per year (9 months)	35,365/-	Cost may vary depending on the availability & price of the determinates like seed, labor, fertilizer etc.
(b) Cost per kg grass	Tk.1.768 or 1.77/kg	It may varies from Tk.0.97-1.87/kg
(c) Income per acre per year(9 months):	40,000/-	@Tk.2.5/kg
Profit:50,000-35,365=14,635/-**per acre per year (9 months)**		

N.B.: Considering 1 Day Labor= 8 Hours Labor

PARA (Brachiaria mutica): Cultivation (Cost Benefit Analysis)

Operation	Cost	Remark
Land preparation		
(a) Ploughing: minimum 15 days interval between the first and last ploughing to remove weeds; **1. By tractor:** 3-4 ploughings, 3-4 days interval between ploughings or **2. By power tiller:** 4-5 ploughings, 3-4 days interval between ploughings	4800/-	1.@ Tk.1200/acre;4 liters of diesel per acre @ Tk. 65.45/- 2. @ Tk.950/acre; 2.5 liters of diesel per acre @ Tk. 65.45/-
(b) Fertilizer application: after 3rd ploughing **1. Chemical fertilizer:** apply 20 kg urea, 25 kg TSP and 15 kg MoP per acre before last ploughing **2. Cow dung:** 2-2.5 tons/acre	320+600+225+200 =1345/- 2000+800= 3,300/-	1. (Urea (Jamuna) @ Tk. 800/50 Kg, TSP(Tunisia) @ Tk.1200/50 Kg &MoP (Canada)@ Tk. 750/50 Kg & ½ d Labor @ Tk. 400/Labor) (Cow dung@ Tk.1/Kg & 2 Labor @Tk.400/Labor)
(c) Laddering: immediately after final ploughing	500/-	@ Tk.500/acre

(d) Herbicide application: **1. Neon:** Dilute 800g in 200 liters of water and spray between the rows 20-25 days after sowing; or, **2. Panida:** Dilute 800g in 200 litres of water and spray on the soil within 3 days of sowing; the soil should be moist (in dry soil the action of herbicide is limited; in that case spray should be applied meticulously)	840+100=940/-	1. Neon-@ Tk. 95/100ml 2.Panida-Tk. @ 105/100 ml (2 hours labor; @Tk. 400/Labor)
Sowing		
(a) Time: February-May		
(b) **Line sowing method/ Plantation:** Either stem or root of the grass can be used for this purpose. It stem is used; it should have at least two to three nodes.	400×6=2400/-	6 labors; @Tk.400/Labor
(c) Line space: 70 cm & cutting to cutting 35 cm		
(d) Seed/Cutting: 12,000 cutting/acre or 480kg /acre	4×480=1920/-	1.@ Tk.4/Kg
Inter-cultural operation		
(a) Weeding: on 30-35th days removal of weeds between lines with small or khurpi	8×400=3200/-	8 labors; @ Tk.400/Labor
(b) Mild irrigation: During rainy season no irrigation is needed. In dry season frequent irrigation is needed.(In summer irrigation is given in every 15-20 days)	500 + 100=600/per irrigation, = (600×12)=7200/-	@ Tk.500/acre (2 hours labor; @ Tk. 400/Labor)
(c) Fertilizer application: @ 20kg Urea/acre, after 30% of cutting plantation & after every harvesting	320+100=420/- per cutting = (420 × 7)=2940/-	Urea (Jamuna) @ Tk. 800/50 Kg (2 hours Labor @Tk.400/Labor)

Harvesting		
Labors for harvesting & carrying (on an average 7 cutting per year) (In first year 6-8 times and 2nd year 7-10 times cutting)	10×400=4000/ per cutting = (4000×7)=28,000/-	10 labors; @Tk.400/Labor
Yield per acre: 45 tons/acre	-	Yield may vary depending on soil condition, climate, and variety of seed, season & many other factors.
Costing		
(a) 1. Total cost of cultivation per acre per year	56,545/-	Cost may vary depending on the availability & price of the determinates like seed, labor, fertilizer etc.
(b) Cost per kg grass	Tk.1.257 or 1.26/kg	It may varies from Tk.0.67-1.37/kg
(c) Income per acre per year:	67,500/-	@Tk.2/kg
Profit:90,000-56,545=33,455/-**per acre per year**		

N.B.: Considering 1 Day Labor= 8 Hours Labor