Analysis of dairy value chain and mapping of potential Solar Chiller Sites in North and South regions of Bangladesh

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<th>Full Form</th>
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<tbody>
<tr>
<td>AI</td>
<td>Artificial Insemination</td>
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<tr>
<td>BMZ</td>
<td>The German Federal Ministry for Economic Cooperation and Development</td>
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<tr>
<td>BRAC</td>
<td>Bangladesh Rural Advancement Centre</td>
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<tr>
<td>BLRI</td>
<td>Bangladesh Livestock Research Institute</td>
</tr>
<tr>
<td>FGD</td>
<td>Focus Group Discussion</td>
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<td>GIZ</td>
<td>Deutsche Gesellschaft für Internationale Zusammenarbeit</td>
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<tr>
<td>HHs</td>
<td>Households</td>
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<tr>
<td>REEEP</td>
<td>Renewable Energy &amp; Energy Efficiency Programme</td>
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<td>MT</td>
<td>Metric Tons</td>
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<td>NGO</td>
<td>Non-Governmental Organization</td>
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<td>NRD</td>
<td>North-Bengal Research Foundation and Development</td>
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<td>FAO</td>
<td>Food and Agriculture Organization</td>
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<tr>
<td>PRAN</td>
<td>Program for Rural Advancement Nationally</td>
</tr>
<tr>
<td>SWOT</td>
<td>Strength, Weakness, opportunity and Threat</td>
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<tr>
<td>SREDA</td>
<td>Sustainable and Renewable Energy Development Authority</td>
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</table>

Acknowledgements

The consultant is grateful to all informants and participants who given valuable time and information to prepare this report, especially data collector, dairy farmer, farm owner, local milk collector, milk traders, goash, gowals, chiller owner, representative of different NGOs and milk processing companies. Many thanks to all others whose names are not cited here but made huge contributions either directly or indirectly towards the successful completion of this assignment. Sincere thanks and appreciation to the GIZ Bangladesh for providing the financial assistance and learning opportunity, out of the support this study would not have been conducted.
Abstract

This study was a part of the NRD consultancy service of Renewable Energy & Energy Efficiency (REEEP) Programme of GIZ, conducted in November, 2017. The broad objective of the study is to conduct the analysis of dairy value chain and mapping of potential solar chiller system at north and southern region of Bangladesh.

Both qualitative and quantitative methods were applied to explore the current dairy value chain situation and select potential sites for a solar chiller system, based on in-depth interviews from 90 participants. The participants were selected who have a number of cows in the village. In addition, 9 FGDs were conducted with mix different mix-group people in 9 sub-districts.

Findings show that the socio-economic status is well-off among the dairy farmers/ farm owners comparing to other villagers. Those who have a milking cow/cow, then they can earn regularly by selling the milk, cow, bulk etc.

There were different types of cows available in the study area; among them 31% local, 2% crossed and 63% Friesian/ Australian/Shindi. The pick time of milk lactation period mostly continues more than 9 months, 66% milk is produced at morning time and usually kept in an open environment. The milk was sold to different customers. The price of the milk fluctuated all the year and low price is common in most of the times at framer/farm level; however the price is increased to three to four times more at end customers. In most of the cases, distances of selling point were observed to be too long. When milk is delivered at the chiller centre, it undergoes the test of quality, density and fat content. If the milk fails to meet the specified standards then it is rejected. So, the quality fault of milk is a great concern for smallholder dairy farmers in the study area.

The milk production volume fluctuates a little bit over the months due to weather change, rainfall pattern, natural pasture amount, amount of feed and management. Most of the participants mentioned that a dairy cattle rearing is one of the most profitable livestock items.

Regarding electricity, about 72% area was grid and 28% was non-grid. Electricity supply from the public grid was unstable in most of the times. The provision of electric grid has usually gone on roadside, so area seems grid but not under the electricity coverage and around 6 to 9 hours load shading happens every day., due to the lack of on-farm refrigeration milk collection has to be either forcibly consumed, sold cheaply to nearby neighbours or hawkers, or is lost. Milk chilling is one of the most important options that is needed in the production and storage of wide range of further milk development. Most of the participants said that solar based chilling system can reduce the spoilages of milk and eliminate the dependency on grid electricity. The local goash, trader, chiller entrepreneurs, and NGOs are interested to invest on solar based chilling plant in the areas.
Analysis of dairy value chain and mapping of potential Solar Chiller Sites in North and South region of Bangladesh

Background and introduction

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH implements the Renewable Energy & Energy Efficiency (REEEP) Programme (formerly known as SED Programme) on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ). This programme is working to ensure sustainable energy delivery and help Bangladesh achieve its vision to become a middle-income country by 2021. Sustainable and Renewable Energy Development Authority (SREDA) is REEEP’s government counterpart. GFA Consulting group, Germany is managing REEEP’s Renewable Energy Programme Component since November 2016. GFA Consulting Group is developing business model for Solar Chiller for dairy industry with the view of providing technical support for implementation of a pilot project. In this connection GFA has intended to hire a national consulting firm/organization. Accordingly, North-Bengal Research Foundation and Development (NRD) has been conducting this study which focuses on understanding the situation of existing dairy value chain and mapping of potential solar chiller sites at north-southern region in Bangladesh.

Statement of the problem

Bangladesh is a small country. The current population is 165,262,311 and it density is 1265 persons per square Kilometre (United Nations estimation on 6th November 2017). With the alarming growth of population, the demand for milk and dairy products rises very fast. The livestock sector currently accounts for about 1.60 % of total GDP, and created 20% directly and 50% partially of employment opportunity. In 2007-08, total number of cattle status was 229 lakh and in 2016-17 it reaches to 239.35 lakh. However, the present demand of milk is 148.65 lakh Metric Tons (MT), whereas production meets only 92.83 lakh MT.

The milk production is one of the most important economic activities in Bangladesh, providing 3.6 million households with supplementary income from this sector. The dairy system characterized by small -scale operations, coupled with crops and other off-farm activities. The governments, Non-government Organizations (NGOs) and private sector initiatives have made progress in transforming dairy into a more value-driven and market-oriented sector. Many findings from other sources depicted that dairy is a prospective sector but poorly developed across the country. However, the development

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2 Value Chain Analysis of Dairy Sector in Rangpur District.
of milk production is a central part of the drive for food security and economic growth of the country\(^5\). Efficient high production has always been a driver in the dairy industry\(^6\). At present per capita milk intake is only 150ml while the required amount is 250 ml/day/head (FAO)\(^7\). But the availability is about 54.65 ml/h/d. This indicates a serious shortage of milk instead of the actual demand. The liquid milk trader, especially traditional gowalas and companies, took advantage of this uncertainty and increased milk price. Moreover, water and powder milk adulteration is a common practice of most of the gowalas across the country\(^8\). Due to tremendous shortage, private enterprises are importing powder milk from abroad. This powder milk which is imported with the cost of huge amount of foreign currency, also concern about the quality and reliability\(^9\).

Milk is a highly perishable item and gets spoiled within a few hours after the production. A significant portion of dairy products produced today is wasted before it reaches consumers or even just before it is consumed. The environment characteristics of Bangladesh is a high ambient temperature, as a result pasteurized milk can only be marketed with cold chain support. It is a great concern for dairy farmer, local collector, traders, dairy producer, milk processors and consumers. Among many factors contributing to the loss, one of the major reason is insufficient storage with cooling facility for the milk supply chain.

The solution to this would be harnessing available renewable energy sources such as solar, biogas, etc. for power generation. Electricity infrastructure is extremely lacking and serves as the main barrier to integrating cold chain capabilities across the supply chain. The solution to this would be to harness abundantly available renewable energy sources. So, this study is worthwhile to explore the situation of the dairy value chain and do a mapping of potential Solar Chiller Sites in North and Southern region of Bangladesh.

**Value chain can make a difference on solar milk chiller system**

Globalization has led to a greater coordination of production in different countries. Yet this global value chains leave individuals, groups and whole regions in disadvantaged positions\(^10\). The term “Value Chain” was used by Michael Porter in his book “Competitive Advantage: Creating and Sustaining Superior Performance” (1985)\(^11\). The value chain analysis describes the activities the organization performs and links them to the organizations competitive position\(^12\). It involves taking a macro look at the interactions and movements within an industry. Raw material inputs acquired ‘upstream’ are transferred into valuable goods ‘downstream’. At each level of supply chain, value-added processes increase the overall process of finished goods, and finally those goods go to the end customer. Normally, sustainable competitive advantages, in relation to competitors, arise from decreasing non-value-added activities, such as excess movements, rework, labor, coordination, and waste, etc. If the consumers are

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\(^5\) Dairy in Bangladesh: problem and prospect; AARES conference paper, p-7.
\(^6\) Managing dairy production costs and ratios.
\(^7\) Bangladesh Dairy: Challenges and opportunities.
\(^8\) Policy Barriers for Dairy Value Chain Development in Bangladesh
\(^9\) Dairy value chain study in Bangladesh, Heifer International Bangladesh
\(^10\) Value chains, local economic development and social inclusion
\(^11\) Competitive Advantage: Creating and Sustaining Superior Performance, By Michael E. Porter.
\(^12\) Value Chain Analysis, Recklies Management Project GmbH.
required to pay the same high prices offered in normal commercial value chains for dairy items, then
they will have not the capacity to afford. Therefore, a reduction in costs is necessary for dairy value
chain model.

Conceptual clarification

**Value Chain:** The value chain is a business tool that identifies ways to create more customers value.
Every firm is a synthesis of activities that perform to design, product, and market, deliver, and support it
products. The Vale chain identifies two main themes;
(a) Primary activities: inbound logistics, operation and out bound logistic, marketing & sales and service
(b) Support Activities: Firm infrastructure, human resource management, technology development and
procurement.¹³

**Operations:** The raw materials and goods obtained are manufactured into the final product. Value is
added to the production line.

**Outbound logistics:** Once the products have been manufactured they are ready to be distributed to
distribution centres, wholesalers, retailers and the customers.

**Marketing and sales:** Marketing must make sure that the product is targeted towards the correct
customer group. The marketing mix is used to establish an effective strategy, any comparative
advantage is clearly communicated to the target group by the use of the promotional mix.

**Service:** After the product/service has been sold the service the organization offers in the form of sales
training, guaranties and warrantees

**Procurement:** This department must source raw materials for the organization and obtain the best price.
They must obtain the best possible quality with the range of the fixed money allocation.

**Technology development:** The use of technology to obtain a competitive advantage within the
organization. The technology can be used in production to reduce the cost thus adds value.

**Human Resource management:** The organization will have to recruit, train and develop the correct
people for the organization.

**Firm infrastructure:** Every organization needs to ensure that their finance, legal structure and
management structure works efficiently and helps drive the organization forward.
(www.themaneger.org).

**Value Chain, External:** The realization that the value chain concept must apply to all members
(suppliers, intermediaries) of the distribution chain and competition is now one distribution value chain
against another.

**Value Chain, Internal:** The many stages involved in taking the raw materials at one end add value as it
moves through the organization. Competitive advantage will only be sustained if every stage is more
efficient and effective than the competition.

**Supply Chain:** The people, technology, organizations and resources involved in moving a product from
producer to consumer.

**Local Entrepreneurs:** Entrepreneurs are storing milk to their chiller and selling milk to different dairy
companies.

**Milk producers:** Milk producers are the main actor and play an important role in the value chain.
The milk producers in the study area were farmer and dairy farm owner who produced milk and sold
to different customer.

**Collector:** Collectors are the person who collect milk at the rural area and then transfer it to the chillers
or processors.

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¹³https://en.wikipedia.org/wiki/Value_chain#/media/File:Porter_Value_Chain.png
Objective
The objective of the study is to conduct the situation analysis of dairy value chain and mapping of potential Solar Chiller Sites along with list of potential investors in dairy sector using parameters such as poverty, production, access to milk processor, consumption, enabling actors and roles, productivity gap indicator, etc.

Study Methodology
Both quantitative and qualitative methods, structured and a semi-structured questionnaire were used to explore the situation of dairy value chain and mapping of solar based chiller system at north and southern area of Bangladesh. The data were collected through interviews, inquiries and observations. The participants’ e.g. dairy farmer, dairy processors, private entrepreneurs, NGOs, stakeholders and prospective entrepreneurs were selected through purposive and random sampling. Purposive sampling was used to select the study village and random sampling was used for targeted informants. In addition, network sampling was also used to find out different value chain linking actors. The Focus Group Discussions (FGDs) were conducted with mix participant groups. The data were cross-checked and validated with triangulation. Secondary sources of data were also used in some cases to explain the value chain and solar dairy chilling related facts and clarifications.

Sequence of study activities:
- Relevant literature about dairy value chain system reviewed.
- Selected and screened 9 districts (focusing on off grid areas) for situation analysis of dairy value chain (milk production and distribution system).
- Developed methodology and questionnaire for data collection and analysis (milk production, own consumption, selling process, and selling price by farmers, seasonal variation of production and consumption etc).
- Prepared an implementation plan and timeline.
- Trained to enumerators on the intervention and questionnaire, deployed enumerators in the field and collect data with support through interviews.
- Focus Group Discussions (FGDs) were conducted with farmer group and related stakeholders.
- Meetings conducted with strategic partners like dairy processors, private entrepreneurs, NGO/who can/ has interest to invest in solar chiller.
- The collected information were analysed by applying value chain, SWOT analysis and data was triangulated by cross sectional checks.
- Provided recommendations of potential sites based on survey result.
- Defined requirements at proper sites for cost analysis.
- Supported to present findings to stakeholders

Study area location map
There are 9 sub-districts of 8 (eight) districts (Rajshahi, Naogaon, Pabna, Bogra, Joypurhat, Khulna, Shatkhira, and Jessore) were selected for the study. The locations are identified in the study map;
Data collection

Total 90 key informants were interviewed and 9 FGDs were conducted to get the real insights of the field. The in-depth interview was conducted with individual dairy framer and farm owner. However,
FGDs were conducted with different mix groups like farmer, farm owner, milk processor, local collector, local milk trader, milk chiller owner, and related stakeholders, detailed are following the table:

Table 1. Distribution of area, informants, data collection and FGDs.

<table>
<thead>
<tr>
<th>Sl.</th>
<th>Division</th>
<th>District</th>
<th>Sub-district</th>
<th>No. of in-depth interview</th>
<th>No. Of focus group discussions (FGDs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rajshahi</td>
<td>Rajshahi</td>
<td>Bagha</td>
<td>10</td>
<td>01</td>
</tr>
<tr>
<td>2</td>
<td>Naogaon</td>
<td>Niamutpur</td>
<td></td>
<td>10</td>
<td>01</td>
</tr>
<tr>
<td>3</td>
<td>Joypurhat</td>
<td>Joypurhat Sadar</td>
<td></td>
<td>10</td>
<td>01</td>
</tr>
<tr>
<td>4</td>
<td>Bogra</td>
<td>Sariakandi</td>
<td></td>
<td>10</td>
<td>01</td>
</tr>
<tr>
<td>5</td>
<td>Pabna</td>
<td>Pabna Sadar</td>
<td></td>
<td>10</td>
<td>01</td>
</tr>
<tr>
<td>6</td>
<td>Pabna</td>
<td>Faridpur</td>
<td></td>
<td>10</td>
<td>01</td>
</tr>
<tr>
<td>7</td>
<td>Khulna</td>
<td>Jessore</td>
<td>Jikorgacha</td>
<td>10</td>
<td>01</td>
</tr>
<tr>
<td>8</td>
<td>Shatkhira</td>
<td>Shatkhira Sadar</td>
<td></td>
<td>10</td>
<td>01</td>
</tr>
<tr>
<td>9</td>
<td>Khulna</td>
<td>Dumuria</td>
<td></td>
<td>10</td>
<td>01</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td>90</td>
<td>09</td>
</tr>
</tbody>
</table>

The consultant and data collector revealed his objective to informants and took consent from them. While taking interview permission was sought. Secrecy and assurance were maintained. The interviewees were asked if she or he agrees to be written his/her the real name in our report, and if a picture is allowed.

**The study findings**

**Socio-economic profile of informants**

The sample had following socio-economic features:

- **Gender:** 32% women and 68% men were interviewed.
- **Education level:** about 22% illiterate and 34% completed primary level, 31% was from secondary (class 6 to 10), 8% was higher secondary class (11 to 12 level), and 5% tertiary level.
- **Age:** The informant’s age varies; majority between 20 to 60+ years.
- **The land ownership status was 16% up to 10 decimal, 23% were 11 to 33 (one Begha), 11% were 34 to 99 (one Accor) and 50% were 100+ respectively.**
- **Income sources:** 38% were fully involved in dairy farming, 15% were involved in dairy with other income sources, 16% agriculture, 12% housewife, 7% business and 10% other like job, auto driver, and student.

92% households were non-poor, 7% were poor and only 1% were ultra-poor\(^{14}\). Majority of the participants in the FGDs revealed that socio-economic status comparatively well-up then other villagers, as they are involved in dairy related activities so everyone have the scope to get more economic

\(^{14}\) According to the poverty strategy 2005 defined criteria. For Ultra-Poor; landless, less than 10 decimal land, 60+ household head, destitute women, no fixed income. For Poor; no regular income, day labor, 10-50 decimal land and non-poor; have regular income, land less than 100.
benefits. Majority of the participants in the FGDs revealed that poverty status is acute in the study area. There is a link with recent survey that shows 57 percent of households in rural Bangladesh are landless, and all together 82% of the rural population can be called “resource poor”. In addition, recent findings reveal that Bangladesh has the highest proportion of people livings under the poverty line in South Asia. They estimated, 31.5% people living under the poverty line in Bangladesh. The rates in neighboring countries are 29.8% in India, 25.2 percent in Nepal, 23.2% in Bhutan, 22.3% in Pakistan, and 8.9% in Sri Lanka. So, this is the socio-economic scenario of study area that impacted multi-dimensional aspects which need to be recognized.

Mapping the dairy value chain and value chain actors and their roles

The dairy value chain was mapped with the consultation of participants during data collection.

A set of activities are involved into the dairy value chain system which determine the costs and effects the profits. The input materials, milk production, collection, storage, cooling, chilling processing, and transportation, distribution, retailing and consuming etc. outputs are changed the end products purchase price. The overall diagram .1 describes how the industry functions.

Diagram 1. Value Chain Map in Bangladesh

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Dairy producers are required pre-cooling facilities near dairy farms, and refer trucks to transport dairy produce from collection center to the centrally located cold storages, processing plants, and finally to the retailers.

The participant mentioned that around **71% raw milk goes to the informal sector** and rest of the percentage goes to formal sector. It was found that farmers and farm owners are producing the pasteurized milk, after that the milk is directly or indirectly sold to the local collectors. The local collectors include Gosh or the agent of chiller/company, individual customers (villagers), local traders (sweet maker/hotels) and milk processors. The informal sector works across the local market and nearby urban areas. The chilling plant plays an important role for further product development in the study area. The milk processor company collects milk from rural and urban market. Detailed formal and informal dairy sector map are given below, adopted from Haifer International, Bangladesh.

**Dairy supply chain map in Bangladesh**
**Dairy cattle status**

A total number of 522 (63%) Friesian/Australian/Shindi, 260 (31%) local/indigenous and 51 (2%) crossbred cows were found at interviewed households and farms in the study area. The distribution patterns of different cattle are shown in the table 1.

<table>
<thead>
<tr>
<th>Type of cattle</th>
<th>Local/indigenous</th>
<th>Crossbred</th>
<th>Friesian/ Australian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk cow</td>
<td>79 (24%)</td>
<td>25 (2%)</td>
<td>220 (68%)</td>
</tr>
<tr>
<td>Dry cow</td>
<td>24 (46%)</td>
<td>3 (6%)</td>
<td>25 (48%)</td>
</tr>
<tr>
<td>Pregnant</td>
<td>86 (41%)</td>
<td>5 (2%)</td>
<td>120 (57%)</td>
</tr>
<tr>
<td>Calf</td>
<td>40 (28%)</td>
<td>7 (2%)</td>
<td>97 (67%)</td>
</tr>
<tr>
<td>Bullock/breeding</td>
<td>31 930%</td>
<td>11 (11%)</td>
<td>60 (59%)</td>
</tr>
<tr>
<td>Total</td>
<td>260 (31%)</td>
<td>51 (2%)</td>
<td>522 (63%)</td>
</tr>
</tbody>
</table>

**Milk production, price and management status**

Cow lactates throughout the lactation period since delivery. About 53% participants mentioned the **peak time of milk lactation continues 6 to 8 months**, after that the amount of milk production slightly decreases on the subsequent months. It was found that **66% milk is produced at morning** and 34% of milk is produced at noon and afternoon. Most of the farmer used silver pot for milking and usually kept an open environment.

About 96% milk was sold to different customers and rest consumed or quality fall. Specifically, 19% sold to the sweet/curd maker (local trader), 8% local customer (villagers), and 13% agent (gosh), and 60% sold to the milk processor companies. In regards to the milk selling price per liter; 23% of farmers sell their milk at BDT 25-30 taka (TK), 61% at 31-35 TK, 14% at 36-40 TK and only 2% at 41 TK plu. During the festivals, special occasions and **Ramadan** price is increased by around 5 - 8tk per liter. The milk selling market is not consistent to some extent; when production is high then market price is less in some of the study. Generally, local vendors (**Goash**) collect milk from the farm then send to the processing or chilling center. In most of the cases, distances were observed to be too long, around 8 to 40 kilometers. When milk is delivered at the chiller centre, it undergoes test the quality and density. If the milk fails to meet the specified standards then rejected. The chilling owner mentioned that around 20% milk they rejected as the quality substandard. This milk framer used to sell in local market with a very low price.

The quality fault of milk is a great concern for smallholder dairy farmers in the study area. Prices of milk supplied to different chilling centres are fixed by fat content, i.e. higher the fat the higher the price\(^\text{17}\). The local chiller owner mentioned that the amount of the fat content is the most important criteria for quality milk. The fat content depends on the price of BDT 3 -8 TK more and less per litter.

\(^{17}\) *Dairy Production, consumption and marketing in Bangladesh*
Milk production fluctuation status

Majority of the participants mentioned that there was a little bit fluctuation of milk production over the year in the study area, as detailed in the graph 1.1. Generally, from June to September the rainfall volume increases. This time flood and water logg decreased the access of grass and sufficient feeds. As result, the milk production volume decreased in the rainy season. This disruption affects the milk supply and availability which subsequently leads to the price fluctuations and hindrence the maximum storage. However, high production of milk persist on from October and gradually increasing trend goes on up to June in the study area.

Status of dairy infrastructure management

The infrastructure management comprises various components, of which the cattle feeding, house pattern, floor type, drainage system, water and electricity access are the main ones:

- It was found that 50% of farmers have the provision of feed in pastures, 48% farmers have grass cultivation practice and only 2% feed inside of the farm.

- Housing pattern: 45% of the interviewed farmers have a building, 39% a tin shed, 7% a homestead made from straw with bamboo and 9% a soil made home.

- The floor types: 66% cemented, 1% tiles and 33% Kacha.

- Drainage system: 54% was cannal, 38 Kacha, and 8% was no sewerage option.

- About 27% were fan to get wind, 72% open and 1% were closed.

- Regarding feeding system: 19% with dais and 81% non-dais.

- Water supply: About 57% farmers were having pipe water supply with deep tubewell 39% Shallow tubewell and 4% Pond/ River. The overall 83% milk farmers in the study area had the improved drinking water access, 8% basic and 9% farmer provided water from river and pond.
Regarding electricity, about 72% area was grid and 28% was non-grid. Majority of participants mentioned that electricity supply from the public grid was unstable in most of the times. The provision of electric grid connection has on roadside, It seems grid area but not under the coverage. Most of the participants mentioned that every day around 7 to 10 hours load shedding happen. In summer session, which is around 9 months, load shedding goes intensively and the rate is increasing day by day.

**Status of human resource & management**

Human resource and technology are the potential area for overlooking dairy management in value chain system. On the subject of training, it was found that only 28% dairy farmers had training but 72% had no training at all. About 87% cattle rearing management conducted by own labour by the individual farmer., About 14 labour were involved in some of the farms.

The labour costs varied from the BDT 4,000 to 8,000 (four to eight thousand taka) for per month.. The participants mentioned that they pay fulltime labour on their dairy management as it is a major source of income generation. Most of the cases, women spend a huge part of the time on feeding, milking and cow dung management activities at household level. Men were mainly involved on collection of the feed from market, feeding at field, and selling milk at the market. In case of disease, 80% had convenient veterinary services. Only 7.60 % farmer received training on dairy farming.

The villagers were more interested to have crossed breed cattle in the study area. Different insemination methods have been practiced in the study area; naturally inseminated 12%, 18% by crossed breed, and 36% Artificial Insemination (AI). Moreover, 34% farmers use both natural, crossed and AI techniques to inseminate. Around 51% mentioned, per breed Insemination cost takes BDT 300-500. All participants were interested to have AI of Shindi/Friesian/Australian breed insemination methods. Different verities of breed cows are available in the study area; most common varieties are Friesian, Australian, Shahiwal, Jersey, Shindi.

**Financial source of dairy farming**

Dairy farming is an important economic activity due to its role in raising household incomes. The farmers were very much interested in investing, but they could not expand as much as expected due to lack of proper financial access. It was found that 77% farmers established their farm by own financing. Around 10% took debt from local Dadon/Mohajon, 7% took loan from bank, 3% from micro credit institutions, 3% cooperatives and 1% from other
sources, detailed on the graph 2. However, 87% mentioned that they may get the loan support from different financial institutions but the processes are complicated, and interest is very high. So, most of them are reluctant loan. Some mentioned they can get micro-credit but regular weekly installment system makes them difficult to pay the instalment. So, affordable financial management of dairy is a key challenge for stallholders’ farmers.

**Status of feed management (Inbound logistics)**

The farmers provide two types of feeds: roughage and concentrates. Roughage includes different grass items like *napier, para*, and *rice straw*. Concentrates include readymade feed, vitamin, rice polish, wheat bran, oil cake, soybean, minerals salts, molasses, sugarcane, plantain calcium, magnesium, and fish meal etc. The feed requirement and cost vary on the basis of the numbers of cows in the farm detailed in the table no2.

<table>
<thead>
<tr>
<th>Table2. Status of feed management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly roughage item requirements</td>
</tr>
<tr>
<td>Weight in kg</td>
</tr>
<tr>
<td>100 -300</td>
</tr>
<tr>
<td>301 - 600</td>
</tr>
<tr>
<td>601 -900</td>
</tr>
<tr>
<td>901-1200</td>
</tr>
<tr>
<td>1201 +</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Overall, monthly 100-300kg roughage items fed provided by 13% of farmer which cost was BDT1000 – 5000. The majority (27%) farmers provided 301 - 600kg feeds and paid around BDT 5001- 10,000. Similarly, 601 – 900kg fed 18%, 901-1200 kg fed 23% and more than 1200kg fed 19% farmer that cost varied from 10,000 to 20,000. The roughage costs were differs depending on the volume of consumption. Farmer also feed different concentrated items for advance growth and increase amount of milk production. It was found that 44% farmer fed around 1-100kg concentrate items per month and paid 1000-5000. Likewise, 101-200kg fed 19% farmer, 201 - 300kg fed 5%, 301-400kg fed 10% and more than 401kg fed 22% farmer. The participants mentioned that concentrates cost are higher than roughages, as a result they could not afford as much as required. Proper feeding is very important which makes a major determent of the productivity and profitability.

**Dairy operation costs**

In the study area, the dairy operation costs differ on the basis of the number of cows and size of the farm. The main operation costs are for buying a new cattle, feeding /roughages, housing, repair/maintenance of housing, treatment, vaccination/ Al, labor, equipment, transportation and utility. Most of the farmer could not able to manage this costs. These cost is a key factor which restricts large
scale processor to reach small scale farmer. Participants mentioned that operation costs are always a challenge,

**Cost of dairy farming**

The study tried to find out the actual investment of dairy farming. Actually, most of the participants could not explain the detailed costing as they were rearing cows since couple of years. About 70% capital expenditure needed for starting a dairy farm. This expenditure refers to the first time investment which includes initial cost of cows, infrastructure and labour. About 25% needed spend for operational expenditure. This cost is second largest expenditure that includes regular feeding, labour, treatment and vaccinations. However, 3% needed of capital maintenance and 2% direct and indirect cost management in the study area. Generally, replacements of cow, maintenance of infrastructure are included in capital expenditure and market promotion of milk, communication materials, and communication with different stakeholders are included on direct and indirect cost.

**Financial return area of dairy sector**

Most of the participant mentioned that a dairy cattle rearing is one of the most profitable livestock activity. The farmer gets return by selling milk, culled cattle, cow dung, calves, access grass, and animal/cow. The Majority, 81% of farmers, get return from milk items. There was a high demand of cow dung for fertilizer and fuel use, 40% get return from it. Cattle selling was also a major return source. During data collection it was found that around 77% farmer got profit, 17% farmer were equal (no profit or no loss) and 6% were in loss on last year. In general, crossed breed rearing farmer gets more profit then local verity. Farmers are more interested in rearing the crossed breed cattle but they could not afford.

**Price value and return profit mechanism**

Most of the participants mentioned that the price of row milk varied from 3 to 5 taka per litter. When social occasion comes i.e. Ramadan, Puja, religious festivals then demand increased, that time price fluctuated around 5-10 take, as there is an increase in demand over the supply. However, value addition
mechanism always increases in trend from the farmer level to the end level customers in value chain system, detailed in the table 5.

Table 5. Price value & return profit mechanism

<table>
<thead>
<tr>
<th>Role</th>
<th>Production or Purchase</th>
<th>Transportation</th>
<th>Labor</th>
<th>Chilling &amp; Cooling</th>
<th>packaging</th>
<th>Utility</th>
<th>Marketing &amp; Branding</th>
<th>Net invest cost (NC)</th>
<th>Sell price (SP)</th>
<th>Sell price / profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy farmer/farm owner</td>
<td>15 tk</td>
<td>1 tk</td>
<td>1 tk</td>
<td>0 tk</td>
<td>0 tk</td>
<td>1 tk</td>
<td>0 tk</td>
<td>18 tk</td>
<td>30 tk</td>
<td>= 12 tk</td>
</tr>
<tr>
<td>Local goash/local traders/Sweet maker</td>
<td>30 tk</td>
<td>1 tk</td>
<td>1 tk</td>
<td>2 tk</td>
<td>0 tk</td>
<td>1 tk</td>
<td>1 tk</td>
<td>36 tk</td>
<td>40 tk</td>
<td>= 4 tk</td>
</tr>
<tr>
<td>Milk aggregators/Processor companies</td>
<td>40 tk</td>
<td>2 tk</td>
<td>1 tk</td>
<td>2 tk</td>
<td>1 tk</td>
<td>1 tk</td>
<td>1 tk</td>
<td>48 tk</td>
<td>58 tk</td>
<td>= 10 tk</td>
</tr>
<tr>
<td>Wholesalers/retailers/chain shops</td>
<td>58 tk</td>
<td>1 tk</td>
<td>1 tk</td>
<td>0 tk</td>
<td>0 tk</td>
<td>1 tk</td>
<td>1 tk</td>
<td>62 tk</td>
<td>70 tk</td>
<td>= 8 tk</td>
</tr>
</tbody>
</table>

*Price value and return profit mechanism on dairy in Bangladesh, NRD,GIZ,2017*

It was estimated that if the farmers investing around 18tk then gets net return profit around 12tk for per litter. Likewise, local collectors/traders need to provide around 36tk and gets profit of 4tk. In the same trend, processor/companies need to invest around 48tk and get around 10tk from per litter. The retailer needs to invest 62tk and gets benefits around 8tk from per litter. An individual farmer sell only his/her milk but other actors sell milk a large quantity, as an aggregator. So, most of the profitable goes to milk collector/traders and processing companies.

Majority of the farmers directly sell the milk to the local buyer/collectors. These local buyers sold mainly to the chilling centre like BRAC Arong dairy, Milk Vita, PRAN dairy, Akij dairy, Quality dairy, etc company. Most of the companies have chilling plants, however they also collected milk from individual chilling plant entrepreneurs at local level. The collected milk used to bring rural chilling centre to central plant (majority onward in the Dhaka capital city) then process again. After processing the milk companies wholesales to the retailer. The retailers are the vendor, professional trader, supper shops in the urban areas. They brought process milk from distributing center of different companies and sell to end consumers.

**Potential site selection**

Due to the lack of on-farm refrigeration milk collection has to be either forced consumed, sold cheaply to nearby neighbours or hawkers, or is lost. Milk chilling is one of the most important options that needed in the production and storage of wide range of further product development. Almost 100% participants are interested to setup the chilling plant to avoid the excess spoilage of milk in the study area. They said that solar based chilling system could reduce the spoilages of milk and eliminate the dependency on grid electricity. The selected area was scrutinized by intensive ground work and consultation with different groups who were involved in site selection process. Regarding pilot project,
the most suitable areas are tabulated on the basis of overall observation, farmer’s interest and priority, the table no 6.

Table. 6. Potential sites for solar based chilling plant at study area.

<table>
<thead>
<tr>
<th>Score</th>
<th>District</th>
<th>Upazila</th>
<th>Area</th>
<th>Total HHs</th>
<th>Area coverage</th>
<th>Production</th>
<th>Chilling facility (CF)</th>
<th>Milk goes informal sector</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Rajshahi</td>
<td>Bagha</td>
<td>Off-grid</td>
<td>2100</td>
<td>19 km</td>
<td>2000</td>
<td>4</td>
<td>No</td>
<td>100%</td>
</tr>
<tr>
<td>2nd</td>
<td>Pabna</td>
<td>Pabna Sadar</td>
<td>Off-grid</td>
<td>400</td>
<td>24 km</td>
<td>4000</td>
<td>4</td>
<td>No</td>
<td>100%</td>
</tr>
<tr>
<td>3rd</td>
<td>Jessore</td>
<td>Jikorgacha</td>
<td>Grid</td>
<td>2000</td>
<td>21 km</td>
<td>7000</td>
<td>10</td>
<td>Yes</td>
<td>65%</td>
</tr>
<tr>
<td>4th</td>
<td>Joypurhat</td>
<td>Joypurhat Sadar</td>
<td>Gird</td>
<td>1000</td>
<td>27 km</td>
<td>1000</td>
<td>3</td>
<td>No</td>
<td>100%</td>
</tr>
<tr>
<td>5th</td>
<td>Bogra</td>
<td>Sariakandi</td>
<td>grid</td>
<td>2500</td>
<td>17 km</td>
<td>4000</td>
<td>9</td>
<td>Yes</td>
<td>60%</td>
</tr>
<tr>
<td>6th</td>
<td>Naogaon</td>
<td>Niamutpur</td>
<td>Off-grid</td>
<td>1500</td>
<td>16 km</td>
<td>3000</td>
<td>2</td>
<td>No</td>
<td>100%</td>
</tr>
<tr>
<td>7th</td>
<td>Khulna</td>
<td>Dumunia</td>
<td>Off-grid</td>
<td>2500</td>
<td>23 km</td>
<td>6000</td>
<td>8</td>
<td>Yes</td>
<td>60%</td>
</tr>
<tr>
<td>8th</td>
<td>Pabna</td>
<td>Faridpur</td>
<td>Grid</td>
<td>1300</td>
<td>14 km</td>
<td>1000</td>
<td>5</td>
<td>Yes</td>
<td>50%</td>
</tr>
<tr>
<td>9th</td>
<td>Shatkhira</td>
<td>Shatkhira Sadar</td>
<td>grid</td>
<td>1000</td>
<td>16 km</td>
<td>1500</td>
<td>5</td>
<td>Yes</td>
<td>60%</td>
</tr>
</tbody>
</table>

The area is recommended for number of strategic regions:
- Mainly off-grid area, while the grid area but electricity is not sufficient.
- Chilling centre is not available.
- Although, some areas have chilling centers but those are not convenient.
- Dairy companies are apparently absent.
- A significant amount of milk is being spoiled every day.
- Farmers always loss a significant amount of benefits
- The areas are within 250 to 300 kilometers of Dhaka, capital city.
- Most of the area is located nearby sub-district and district (urban area).
- The dry season is continuing around 9 months; dairy cow grazing is available in most of the areas.

Table 7. Tentative requirements & cost for sites

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Requirements</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk handling capacity</td>
<td>1000 litter per day</td>
<td>Cost little bit less or more depending on the size and capacity</td>
</tr>
<tr>
<td>Land required</td>
<td>200 -250 SQ feet</td>
<td></td>
</tr>
<tr>
<td>Power required</td>
<td>15-100 KW</td>
<td></td>
</tr>
<tr>
<td>Man power (2 person)</td>
<td>500 – 800 salary day</td>
<td></td>
</tr>
<tr>
<td>Cost of set up</td>
<td>3.5- 5lacs</td>
<td></td>
</tr>
</tbody>
</table>
## Potential investors and dairy actors

<table>
<thead>
<tr>
<th>S</th>
<th>District</th>
<th>Upazila</th>
<th>Potential investors in dairy sector</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Milk processor</td>
</tr>
<tr>
<td>2</td>
<td>Pabna</td>
<td>Pabna Sadar</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Jessore</td>
<td>Jikorgacha</td>
<td>BRAC Arong, PRAN dairy</td>
</tr>
<tr>
<td>4</td>
<td>Joypurhat</td>
<td>Joypurhat Sadar</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Bogra</td>
<td>Sariakandi</td>
<td>BRAC Arong, PRAN dairy</td>
</tr>
<tr>
<td>6</td>
<td>Naogaon</td>
<td>Niamutpur</td>
<td>Akij, Gosh</td>
</tr>
<tr>
<td>7</td>
<td>Khulna</td>
<td>Dumuria</td>
<td>BRAC Arong, PRAN dairy</td>
</tr>
</tbody>
</table>

The local goshs, traders, chiller entrepreneurs, and NGOs are interested in investing in solar based chilling plants in the areas. People are very much eager to have this option during discussion. Some areas are very isolated however the infrastructure, financial access, milk collection point and distribution networks are very convenient for the pilot project. Generally, milk is collected from dairy farmers. Farmers are paid a fixed price for milk upon delivery to the collection centre. Raw milk is brought to a chilling facility in the morning and evening by bicycle rickshaw and is stored at the facility until trucks picks it up and bring it to the factory.\(^\text{18}\)

\(^{18}\) *Grameen Danone Food Limited (GDF). International Food and Agribusiness Management Review*
**SWOT analysis**

The dairy sector value chain found a number of strengths, weaknesses, opportunities and threats.

<table>
<thead>
<tr>
<th><strong>Strengths</strong></th>
<th><strong>Weaknesses</strong></th>
<th><strong>Opportunities</strong></th>
<th><strong>Threats</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced mortality rate of dairy cows where the cattle are tolerant to climate and environmental condition</td>
<td>Wastage of milk due to lack of storage opportunity</td>
<td>Possibility of intensive dairy business</td>
<td>The high cost of feeds</td>
</tr>
<tr>
<td>Positive attitude of the farmer towards dairy farming</td>
<td>Milk processor stop collection milk without previous notice that time milk is thrown</td>
<td>Cross breeding dairy cow population increased day by day</td>
<td>Disease of cattle</td>
</tr>
<tr>
<td>The area is suitable to agro-climatic conditions</td>
<td>Most of the farmer could not get the advantage of cross bred</td>
<td>Increasing customer on dairy products</td>
<td>Monsoon floods</td>
</tr>
<tr>
<td>The farmers are interested in crossbreeds and in increasing the genetic of cows</td>
<td>Long calving interval</td>
<td>Farmers or farmer group can establish milk storage and processing of milk</td>
<td>Political unrest i.e. road blocked</td>
</tr>
<tr>
<td>Farmers are rearing highly produced milking cows</td>
<td>Lack of proper cattle environment i.e. lack of disposal management, lack of proper cleaning procedure for milk utensils</td>
<td>Dairy can be linked with different companies</td>
<td>Farmers have not enough knowledge what type of medicine should be provided in case of cow’s diseases</td>
</tr>
<tr>
<td>The financial institutions are willing to support the dairy value chain program</td>
<td>Lack of proper milk storage system at household level.</td>
<td>The villagers who have limited amount of land can become dairy farmer</td>
<td>Farmers depend on other’s service provider on reproductive support</td>
</tr>
<tr>
<td>Women are very active in dairy management</td>
<td>Low productivity of dairy cows</td>
<td>Capacity building can be developed</td>
<td>Credit/ cooperative pay loan with high interested and sometime apply condition</td>
</tr>
<tr>
<td>Milk demand is high</td>
<td>Lack of proper care of cattle</td>
<td>Strong communication with livestock department and dairy related</td>
<td></td>
</tr>
<tr>
<td>A number of the farms have already been established</td>
<td>Lack of farmers knowledge on milk pricing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lack of reliable breeding service,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lack of awareness to take training on dairy</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
- Around one third of the area is off-grid
- Different stakeholders are interested in investing in solar chiller

<table>
<thead>
<tr>
<th>management</th>
<th>actors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of enough processing facilities</td>
<td>Composting of cow dung for fertilizer and alternative fuel</td>
</tr>
<tr>
<td>No laboratory &amp; milk quality measurement facility</td>
<td></td>
</tr>
<tr>
<td>Traditional milk processing and marketing system</td>
<td></td>
</tr>
</tbody>
</table>

**Conclusion**

The dairy system in the study area is characterized by individual farmers, small and medium-scale operations, with a number of agricultural activities. It was found that the production, consumption and dimension of dairy activities have increased day by day. Both formal and informal value chain co-exist in the study areas. The farmers/ farm owners supply raw milk to both traditional market and processing companies where value is added by 3 to 4 times more i.e. liquid milk, chocolate, ice-cream, butter etc.

The collection networks has increased at urban level but this has not increased at local level. As a result, most of the time marginalized farmers/farms get less amount of profit but customers’ needs to pay a high price. So, there have a significant value chain gap into the entire system, as result majority portion of the poor/middle income population could not buy the dairy items. Whilst, milk production is one of the most important economic activities of livestock sector but there have noteworthy lack of access of on-farm dairy storage and processing system. In that cases, solar based chilling plant may be the sustainable option to manage the on-site dairy system in the study area.
Reference


Annexes: Some photographs of study areas.