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Expansion of milk value chain in Punakha District of Bhutan

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Expansion of milk value chain in Punakha District of Bhutan

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DEDICATION

I dedicate this Master Thesis to my mother Phurpa Lhamo, wife Kezang Lhadon, and two lovely sons Rigzin Norbu and Tandin Norbu.

"It is more important than ever to make our families the centre of our lives and the top of our priorities"

- L. Tom Perry

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LIST OF ABBREVIATIONS

AI	Artificial Insemination
BAFRA	Bhutan Agricultural & Food Regulatory Authority
BTS	Bhutan Trade Statistics
CH&BPP	Contract Heifer & Bull Production Program
COP	Cost of Production
DAMC	Department of Agriculture & Marketing Cooperatives
DFGs	Dairy Farmers Group
DLS	District Livestock Sector
DoL	Department of Livestock
FAO	Food and Agriculture Organisation
FGD	Focus Group Discussion
FYP	Five Year Plan
GDP	Gross Domestic Product
Gm	Gram
GNHC	Gross National Happiness Commission
IFAD	International Fund for Agriculture Development
IIRR	International Institute of Rural Reconstruction
KI	Key Informant
KIT	Royal Tropical Institute
MCP	Milk Collection Point
MPU	Milk Processing Unit
MT	Metric Tonne
NSB	National Statistical Bureau
RGoB	Royal Government of Bhutan
RLDC	Regional Livestock Development Centre
RNRSD	Renewable Natural Resources Statistics Division
SDGs	Sustainable Development Goals
SPSS	Statistical Package for the Social Sciences
SRFL	State Reserved Forest Land
TMR	Total Mixed Ration
UNDP	United Nations Development Programme

Bhutanese Terms

Dzongkhag	District
Geog	Subdistrict
Ngultrum	Bhutanese currency (1 Euro = Ngultrum 78)
Tsamdrok	Community grazing land

ABSTRACT

Dairy farming in Punakha District is kept mainly for subsistence; however, the trend is picking up towards commercialisation. The demand for dairy products in the market is also increasing with high marketing scope, mainly from urban settlement and neighbouring district. However, the concept of the formal milk value chain is fairly new in the district and the milk collected from these dairy producers fails to meet the quantity required by the milk processor to cater to the consumers' demand for dairy products. Therefore, this study intends to identify the possibilities towards increased milk supply to facilitate milk processor in organising milk collection for better economic gains and develop an inclusive business model along the milk value chain in Punakha district.

Survey, key informant interviews and focus group discussion were used as field research strategies to obtain relevant information. The survey was conducted using both open and closed-ended structured questionnaire at identified villages with organised dairy farmer groups in seven subdistricts of Barp, Dzomi, Guma, Kabisa, Shelnga-Bjemi, Talog and Toedwang in Punakha district. A total of 60 respondents; 30 existing milk suppliers and 30 non-milk suppliers were drawn using simple random sampling technique. One-to-one interviews were conducted following semi-structured questions with eight key informants in the chain. One focus group interview was conducted with the existing dairy farmer groups representatives to triangulate and discover in-depth information about expanding the milk value chain in the district. The survey data was analysed using the Statistical Package for Social Sciences software version 20. A method of grounded theory design was used to analyse the qualitative data of interviews and focus group discussion. Value chain mapping and Business Model Canvas analysis were employed for assessing the operational situation of the current milk chain.

The study found that the daily mean milk production by each household was higher in DFGs which was found to be 12.23 ± 7.89 litres in comparison to 8.75 ± 5.03 litres in Non-DFGs. The mean cost of milk production was estimated at Nu.27.53 per litre and the maximum expenses were incurred in animal feeds which were estimated to be 46.34% of the total cost of milk production. In this study, milk producers had the highest share of added value and profit which were estimated at 45.45% and 44.85% respectively. The study also shows that the current business model lacks some aspects of key activities, resources and partnership efficiency especially on the quantity and quality of milk supplied in the processing unit. Limited information and coordination amongst stakeholders have contributed to slow progression in the formal milk market.

The finding reveals that 90% of Non-DFGs respondents were interested in joining formal milk marketing. The average morning milk available for supply from this group would be 4.41 ± 3.07 litres daily by each household. The study also found that 50% of the respondents were interested in supplying evening milk with an average of 4.43 ± 2.25 litres per day per household. There is strong government support to improve genetic potentials of dairy animals, feed and fodder resources, farmer groups mobilisation, and capacity building on dairy husbandry practices.

Based on the result of this study, it was concluded that there are possibilities of expanding the milk value chain in the district. However, there is a need to enhance consistent milk supply through a quality-based milk payment system, access to reasonable input supplies, and facilitate strong multi-stakeholder processes along the milk value chain.

Keywords: Business Model Canvas, Dairy farmer groups, Milk, stakeholders, Value chain

CHAPTER I: INTRODUCTION

1.1 Background

Dairy farming is a primary livelihood income for most of the rural population in developing countries. With more concentration on dairying, dairy farming and production trends in developing countries are increasing over the years. In most of the countries, milk produced by smallholder farmers play an essential role in the dairy value chain, and milk production contributes directly to household livelihood, food security and nutrition (Chagunda, et al., 2016). The global milk output was recorded at 811 million tons in the year 2017, which is 1.4% higher than in 2016 (Food and Agriculture Organisation [FAO], 2018). Particularly, in Asia, the milk output increased by 1.9% with a significant contribution from India and China.

The economy of Bhutan is tiny, with only Gross Domestic Product (GDP) of US Dollar 2,036 million at the current market price (National Statistics Bureau [NSB], 2018). The share of Livestock, Agriculture and Forestry during the same year was 16.52% to the national GDP. Livestock alone contributes to 3.89% of the GDP and about 22% of the rural household income (NSB, 2018). Dairying in Bhutan is a very important economic activity to the farmers and a flourishing sector with various resources and potentials. By volume, 21.88% of liquid milk is consumed in the country out of 50,250.50 MT of milk produced in 2017 (Department of Livestock [DoL], 2018). It has also reported that self-sufficiency for fresh milk, butter and cheese combined is 88.80% as of 2017 (DoL, 2019). Thus, during the 11th Five Year Plan (FYP), per-capita availability of milk has increased from 113gm per day in 2012 to 175gm per day in 2017 against the FAO recommendation of 200gm/person/day. According to Renewable Natural Resources Statistics Division (2017), Bhutan imported about 4,356 MT of milk and other dairy products from other countries particularly India and Thailand.

Dairy farming in Punakha District is kept mainly for subsistence; however, the trend is picking up towards commercialization. Out of 6,079 households in the district, 30.71% (n = 1867) of the families owns dairy cattle (DoL, 2018). The district has 11,045 cattle heads with improved dairy cattle of jersey and brown Swiss breeds accounting to about 30% of the total cattle population in the year 2017. The DoL (2018) also indicated that close to 1251 MT of milk is being produced in the district, achieving milk self-sufficiency of about 62%. The rest 38% of the milk shortfall is being imported from a dairy processing company within the country as well as from India in the form of fresh milk and tetra pack milk respectively. The district has to put a further concerted effort to attain self-sufficiency in the dairy sector by taking realistic approaches. The district livestock sector during the 11th FYP (2013-2018) had worked closely with relevant stakeholders to enhance production, market access and innovation in the dairy sector and is mandated to focus on a similar approach of mainstreaming value chain in 12th FYP (2018-2023) as documented in 12th FYP of Livestock Department (DoL, 2019). The district recognises collective action through Dairy Farmer Groups (DFGs) as a positive force for developing the dairy sector and has formed 19 DFGs so far. In the year 2017, five DFGs from four subdistricts of Dzomi, Guma, Kabisa and Toedwang with a total of 99 members have started fresh milk supply and marketing at Khuruthang town in Punakha district (District Livestock Sector, 2017).

Khuruthang town in Punakha is getting a significant facelift in recent years. The demand for fresh milk and dairy products in the market is increasing with high marketing scope, mainly from urban settlement and neighbouring district (Regional Livestock Development Centre [RLDC], 2015). Going by this trend, the need for milk is anticipated to increase further in the future with a growing population and an

increase in purchasing power. In addition, with the increasing awareness on the importance of dairy products in healthy diets, the demand for milk and milk products is expected to increase in the future. Besides, the improvement in the road connectivity and improved transportation facility in the district has further contributed an enabling environment for the marketing of dairy products. However, the milk delivered by the existing dairy farmers is insufficient for the milk processing unit to meet the consumer demand and diversify into other dairy products for better economic gains.

1.2 Problem Statement

The existing DFGs cumulatively supply an average of 240 litres of milk daily to the milk processing unit (MPU). The main constraint perceived in expanding milk value chain is insufficient milk supply. As a result, the milk processor is not able to use maximum plant capacity (1000 litres/day) to collect, process and sell milk and milk products for better economic gains. Thus, this study will respond to the need for clear analysis and the possibility of expanding the milk value chain in the district. The research will also enhance the decision-making ability of the milk processor, other chain actors and supporters to invest in expanding the milk value chain.

1.3 Objective

To identify the possibilities towards increasing milk supply to meet the existing daily plant capacity of processing 1000 litres at the end of June 2020 for better economic gains and facilitate developing an inclusive business model along the milk value chain in Punakha district.

1.4 Research Questions

1. What are the constraints of the existing milk value chain in Punakha district?
- What is the quantity of milk supply through formal and informal value chain?
- What influences milk supply through the formal and informal chain?
- What is the quality of milk supplied to the chain?
- What is the value of profit margin share in the value chain?
- What are the gaps in the existing chain at actors and supporters' level?

2. What are the opportunities to expand milk value chain in Punakha district?
- What is the perception of the dairy farmers on expanding the existing chain?
- What is the quantity of additional milk supply from existing and new dairy group members?
- What is the readiness of chain actors and supporters to invest in improving the existing chain?
- What is the existing business model of milk processor in the chain?

1.5 Definition of the concepts

The value chain is defined as the range of activities from production, processing and marketing of a particular product (KIT and IIRR, 2010).
Value share refers to the percentage of the final retail price that the actor earns calculated by multiplying added value 100 divided by the retail price (KIT and IIRR, 2008).
Dairy farmers' group refers to a group having not less than three members from three different households and deriving economic benefits from one or more economic enterprises related to renewable natural resource sector (Department of Agricultural and Marketing Cooperatives [DAMC], 2010).

CHAPTER II: LITERATURE REVIEW

As part of the literature study, the literature on the dairy production system, value chain, value share, roles of stakeholders, quality milk supply, determinants of increased milk supply, and chain sustainability were reviewed from various public sources on the internet, books and statistical data from the relevant organisation.

2.1 Dairy Production system in Bhutan

Dairy farming in Bhutan advanced over centuries with the integration of agriculture, livestock and forest for grazing into a mutually supportive system (Bhujel and Sonam, 2014). Dairy is an essential part of farming systems and signifies a better source of livelihood in the world. Dairy animals are raised for various reasons such as milk, meat, manure, draught power, as a source of income and as assets. According to Hemme and Otte (2010), close to 12 to 14% of the world population is dependent on dairy farms or can be categorised within dairy farming households. With more emphasis on dairying, dairy farming and production trends are increasing over the years in developing countries. In most of the countries, milk produced by smallholders' farmers play an indispensable role in the dairy value chain, and milk production contributes directly to household livelihood, food security and nutrition (Chagunda, et al., 2016).

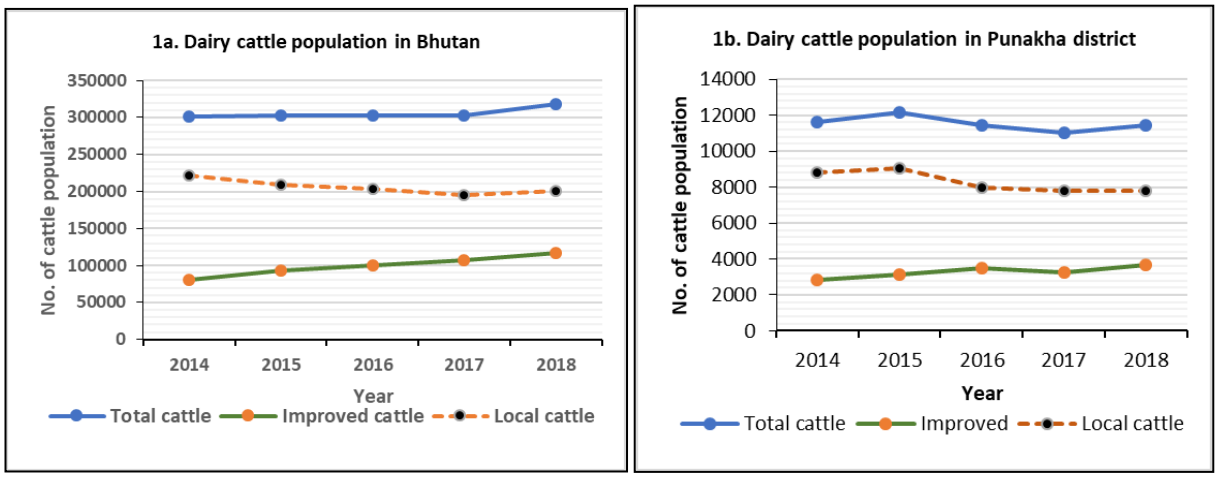
The dairy production system in Bhutan can be categorised into transhumant and sedentary (Phangchung, et al., 2002; IFAD, 2015). Transhumant cattle production system refers to the seasonal movement of livestock between winter and summer pastures where their roles are multifunctional because of its complex interactions with the environments and societies (Ragkos, et al., 2013). The sedentary system according to Phangchung, et al. (2002) is crop-cattle system kept around the homestead and having two to eight cattle head in a herd. Similarly, the United Nations Development Program (2016) classified the dairy production system of Bhutanese dairy farmers' as traditional and improved production systems which relates to the transhumant and sedentary dairy cattle production system. Currently, there are about six cattle breeds (Jersey, Brown Swiss, Holstein Friesian, Karan Fries, Mithun cross, native) raised for milk production in Bhutan.

As shown in **Figure 1a**, the population of crossbred cattle during the year 2014 and 2018 increased by over 45%, while the indigenous cattle population decreased by over 9% and the overall cattle population increased by over 5% (DoL, 2014; 2015; 2016; 2017; 2018). Bhutan has spent considerable resources and efforts in improving the dairy cattle breeds since the start of the First Five-Year Plan (FYP) in 1961. The success of the increasing crossed and exotic breeds cattle population in most of the developing countries is credited to long-term government support to the dairy producers by having easy access to cheap long-term credit, veterinarian services, reasonable livestock inputs price and marketing support (Ahuja, 2012).

Dairying in Punakha district is largely kept for subsistence; however, the trend is settling towards commercialization. Out of 6,079 households in the district, 30.71% (n = 1867) of the households owns dairy cattle (DoL, 2017). **Figure 1b** shows the trend in dairy cattle population for the last five years between 2014 and 2018. The trends show that population of crossbred cattle increased by over 30%, while the indigenous cattle population decreased by over 11% and the overall cattle population decreased by nearly 2% (DoL, 2014; 2015; 2016; 2017; 2018). According to Bhujel & Sonam (2014), the

average cattle holding in the humid subtropical region similar to Punakha district is five cattle head per household

Figure 1. Dairy cattle population trends



Source: DoL (2014-2018)

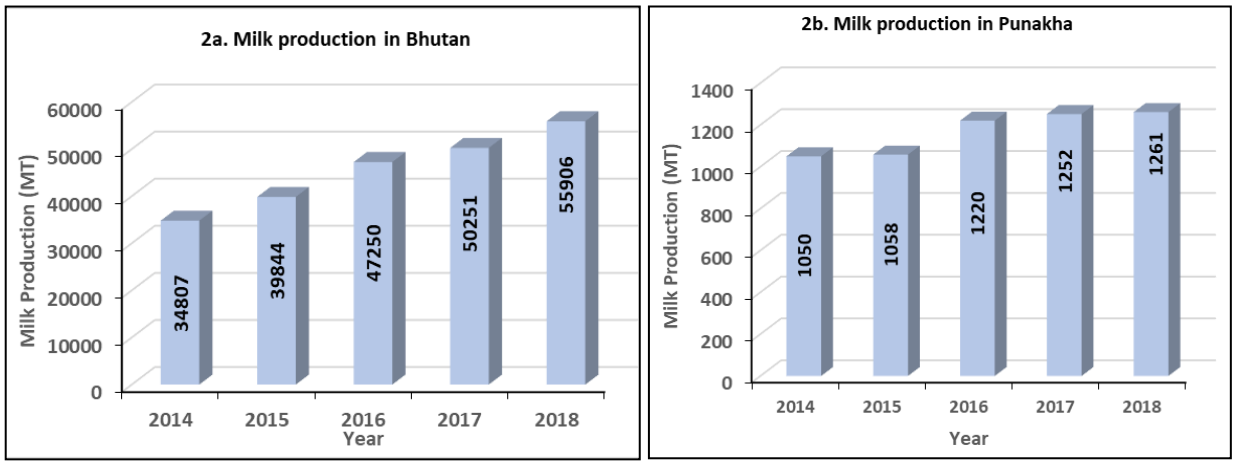
2.2 Milk production trends in Bhutan

The milk production at the national level stood at 55,906 MT in 2018 which is an increase of over 60% from 2014 (**Figure 2a**). At the end of 11th FYP (2013-2018) the country was able to increase 69% more from the baseline target of 29,625 MT in 2013 (Gross National Happiness Commission [GNHC], 2013). The dairy sector had geared towards fulfilling the FAO daily per capita requirement of 200 gm of fresh milk per person per day. The average per capita milk consumption for Bhutan stands over 68 kg of milk per year, while the average global milk consumption according to Hemme & Otte (2010) was about 100 kg of milk per year, indicating significant differences between developed and underdeveloped countries. The per capita consumption in Western Europe is higher than 300 kg of milk per year, while in some underdeveloped countries, it is less than 30 kg (Hemme & Otte (2010).

India is the primary source of import of milk and milk products for Bhutan mainly tetra milk and powder milk (Department of Revenue and Customs, 2018). Bhutan imported close to 5000 MT milk and 1987 MT milk products in the year 2016 (Bhutan Trade Statistics, 2017). Considering the import figures and primary focus of the MoAF to reduce import of milk and milk products in Bhutan, there are opportunities for dairy producers in substituting the import with domestic production and supply.

Figure 2b below illustrates the overall milk production trend of the district. The milk production at district level from dairy groups and individual farmers stood at 1261 MT in 2018 which is an increase of over 20% from 2014 (DoL, 2014; 2015; 2016; 2017; 2018). The domestic milk production in the district is very low based on the per capita consumption requirement of 200gm of milk per day. This information provides that Punakha can afford to produce milk by mainstreaming dairy value chain development in the district.

Figure 2. Milk production trends



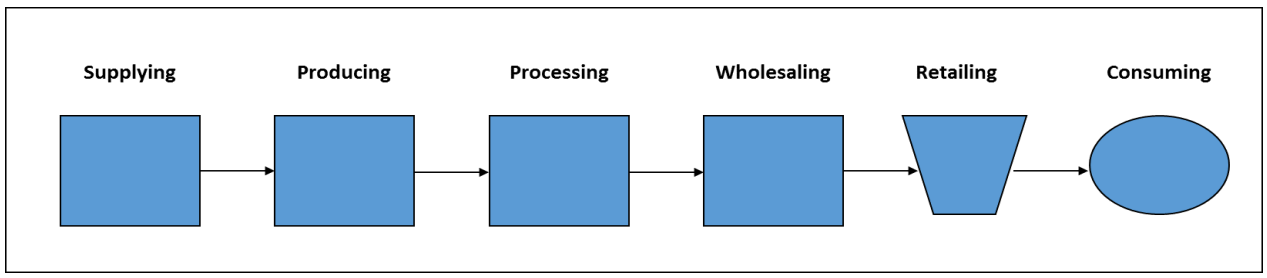
Source: DoL (2014-2018)

2.3 Value chain

2.3.1 Description of the value chain

KIT & IIRR (2010) defines value chain as the range of activities from production, processing and marketing of a particular product. Similarly, Kumar and Rajeev (2004) describe a value chain as a process which can be looked up every step from the procurement up to the end-users of goods or services. According to KIT, et al. (2006) value chain is a specific type of supply chain wherein actors actively support each other to increase their efficiency and competitiveness towards achieving shared goals and objectives. The simple value chain model applicable to the dairy value chain is presented in **Figure 3**.

Figure 3. Simple value chain model



Source: Adapted from APCM (2018)

2.3.2 Value chain approach

Taking a value chain approach requires understanding a market system to recognise and integrate the implications of the constraints which may lead to inadequate and short-term impact (Coulibaly et al., 2010).

Findings of Achchuthan and Kajananthan (2012), in their studies on value chain analysis in dairy sector Kilinochchi district, Sri Lanka opined that the value chain approach starts from an understanding of consumer preference and working its way back through distribution channels to different stages of production, processing and marketing. There is a growing interest in mainstreaming value chain approach as developmental tools, particularly in developing countries. The study of Feller, et al. (2006) revealed that the growing interest for value chains began with Porter's seminal work "Competitive Advantage" which was developed and popularised in 1985.

According to Humphrey and Navas-Aleman (2010), many institutions and donor agencies use the value chain approach as part of their toolkit to promote developmental activities in a way that increases economic growth and reduce poverty. Value chain approach supports decision-makers responsible for integrating the goals and targets of the 2030 agenda for Sustainable Development Goals (SDGs) into national policies and programmes. The value chain approach was instituted to implement SDGs goal of reduced inequalities during the 11th FYP in Bhutan and recommended a similar approach in 12th FYP by working closely with the private sector to enhance production, market access and innovation in agricultural areas (GNHC, 2018)

2.3.3 Scenarios of a dairy value chain

The present situations of a dairy value chain in developed and developing countries are different. In case of the dairy value chain in a developed country like the Netherlands, the scenarios of a future dairy value chain are intended towards producing differentiated raw milk with improved manufacturing practices, reduced the production of individualistic dairy products and shift towards environmentally sustainable dairy farming with improved animal welfare. This was revealed by Demeter, et al. (2009) in their studies on scenarios for a future dairy chain in the Netherlands indicating that there is a need for rigorous and harmonised actions by the various actors and stakeholders in the dairy chain.

However, for developing countries, the scenarios of a dairy value chain are still in infant stages. The study conducted by Muhamma, et al. (2014) on dairy supply chain management and critical investigations on dairy informal channel partners in Pakistan revealed that without formal dairy value chain, most of the milk producers and consumers are facing economic, social and health losses due to informal dairy supply chain partners.

The United Nations Development Programme [UNDP] (2016) in their studies on the value chain and market analysis of Renewable Natural Resources Products in Bhutan reported that the surplus milk and milk products produced by the typical Bhutanese dairy farmers' are sold both through the informal and formal markets. The author refers informal system for the sells of milk and milk products to neighbours and in the local market, while formal system refers to the collection of milk through organised dairy farmers' group initiative at the milk processing unit. The report also mentioned that with the mobilisation of dairy farmers' group and dairy-related enterprises, the market for milk is beginning to expand and opportunities of the dairy sector are remarkable with urban markets growing each year, and the demand side of milk is increasing. Reports by the International Fund for Agricultural Development (2015) argued that dairy constitutes one of the highest import categories in Bhutan and is one of the commodities to be taken up for integrated value chain development.

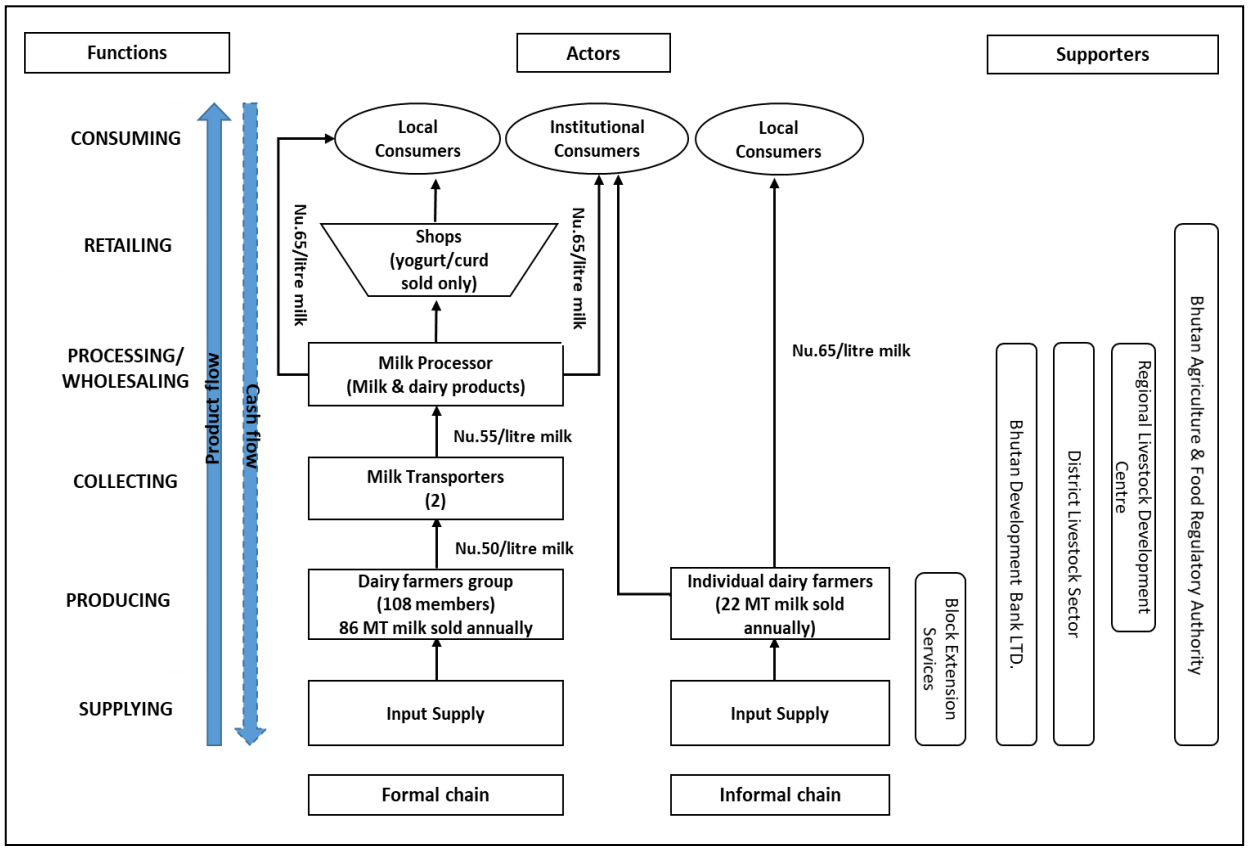
The value chain in Punakha district has both formal and non-formal milk marketing system (**Figure 4**). The formal market is functioned mainly by organised DFGs and links the market in a coordinated chain.

The informal market is primarily practiced by individualist dairy farmers that are not registered in a group.

Chain Actors: The dairy producers procure their inputs (concentrates, fertilizers and ingredients for ration formulations) from an authorized feed dealer. Both DFG members and non-members deliver the milk to the MPU through identified milk transporters who collects morning milk from various milk collection points. The milk processor makes the payment for the milk collected through milk transporters on a monthly basis. The MPU does processing, packaging and wholesaling, while, fresh milk and some products are sold directly from MPU shop to the local consumers, institutions, hoteliers and resorts.

Chain Supporters: Livestock sector is responsible for providing extension and animal health services, capacity development, and subsidy support package as per the policy guidelines of the department to the dairy farmers. Bhutan Development Bank Limited (BDBL) which is mandated for agricultural financing supports the chain actors by providing loans. The post-production and market development unit under RLDC is responsible for coordinating post-production activities from milk collection, cooling, packaging and marketing, while Bhutan Agriculture and Food Regulatory Authority (BAFRA) is a regulatory authority which regulates the quality of milk and milk products from collection until the end-users (consumers).

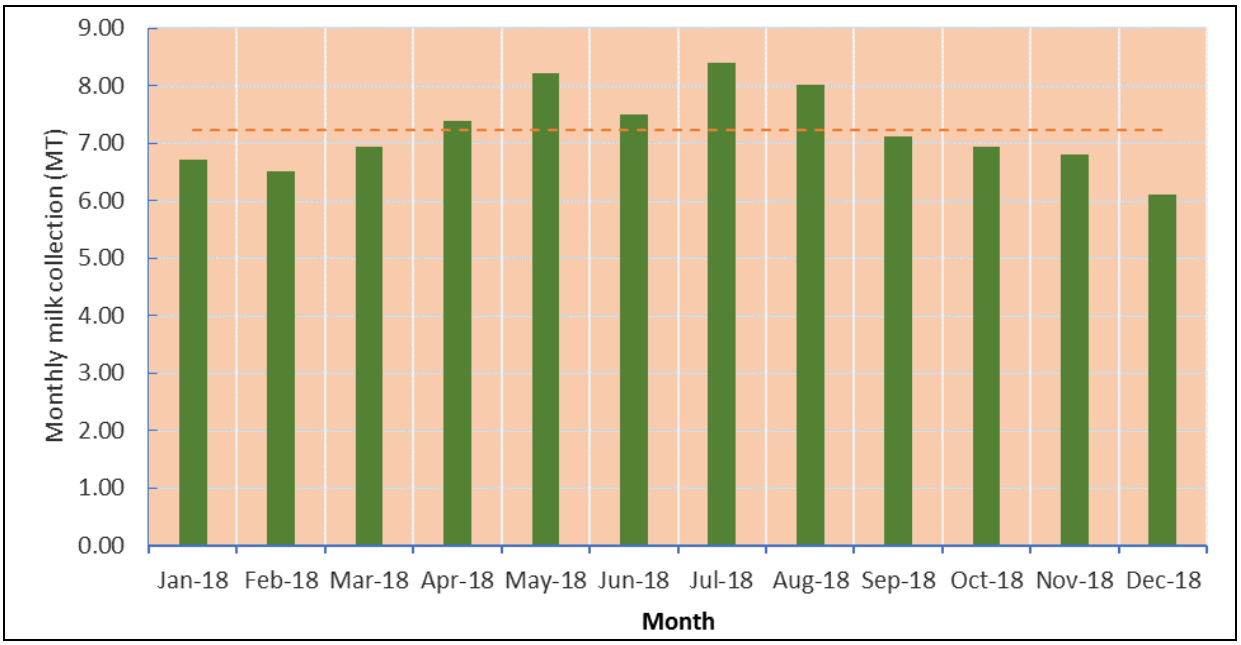
Figure 4. Analysis of existing milk value chain



Source: Adapted from Spotlighting unpublished report (Ugyen, 2018)

The total milk production in the district as per the Livestock Statistics 2018 was 1261 MT in the year 2018 recording a positive growth every year. The statistics also indicated that 108 MT of milk was sold as fresh milk through formal and informal milk market. Similarly, the data maintained by DLS recorded a little over 86 MT of milk collection by MPU in 2018 through the formal milk market (**Figure 5**) which is 79.63% of the total estimated fresh milk marketed in the district**.** This informs that the remaining 20.37% (22MT) of the total fresh milk sold was marketed through informal marketing channel in that particular year. The study also found out that only 6.82% of the total milk production in the district during 2018 was sold through formal milk collection channel. This shows there is a scope for expansion of formal milk marketing through intensification of milk-collection networks to collect all the milk produced in the district as well as to capture ongoing volumes sold through informal milk market.

Figure 5. Quantity of milk collected by milk processor in the year 2018



Source: District Livestock Sector, Punakha (2019)

2.3.4 Value share of actors in the milk value chain

The market force mostly drives the pricing of milk and milk products in Bhutan with little importance on compositional quality. A study by Wangdi, et al. (2014) on the pricing of domestic dairy products in Bhutan found that market forces determine the price and there is no legal standard to base the market price. The cost of producing (COP) milk is not taken into account for fixing the price of milk and milk products, and without knowing COP of milk, the determination of total business profit in different chain function is impossible. Studies conducted by Galen and Hoste (2016) found a bad connection between price developments and income distributions at various stages of chain functions, making it difficult to trace and remove hindrances in the value chain.

To calculate value shares of actors in the value chain, it is necessary to know the costs and revenues as follows (KIT and IIRR, 2008).

- **Gross margin** is the gross profit per unit of production and is calculated by dividing the total income by the revenue earned from sales.
- **Added value** is the amount of value that each actor in the chain adds. It is the difference between the price the actor pays for the product and the amount he or she sells it.
- **Value share** is the percentage of the final, retail price that the actor earns calculated by multiplying added value 100 divided by the final retail price.
- **Net income or net profit** is the real profit that the actor makes calculated by deducting total costs from total revenues**.**

2.3.5 The role of dairy farmers group

In Bhutanese context, Farmers Group is defined as a "group having not less than three members from three different households and deriving economic benefits from one or more economic enterprises related to renewable natural resource sector" (DAMC, 2010). The concept and formation of farmers into DFGs for collection, processing and marketing of fresh milk and processed products came up intensely since the early 1990s through Highland Livestock Development Project, a livestock development project (Sonam and Martwanna, 2011). According to Sherpa (2010), farmer groups approach in eastern Bhutan started strongly since the early 1990s by supporting the farmers to change from subsistence level of production towards market-led enterprise development through Agriculture Marketing & Enterprise Promotion Programme. The results are clearly visible and Samdrupjongkhar is the first district to have achieved self-sufficiency in milk production and excess milk productions are being exported to the border town of Assam in India (Namgyel, 2018). Currently, the district has 16 functional DFGs producing and supplying milk in the milk processing plants.

The number of livestock oriented farmer groups in Bhutan has increased remarkably, with over 167 organised groups registered at the national level (DAMC, 2019). The growing numbers of dairy groups in the country are vital towards progressing the dairy sector to the next level. Punakha district has 19 dairy groups with three groups registered at the national level and is currently involved in fresh milk supply and marketing, and sales of cottage cheese and butter (DAMC, 2019).

Farmers group is an integral component of effective production and management of dairy products besides helping the farmers themselves to boost their livelihood income. Mugoya and Rwakakamba (2010) suggested that farmers group can be a tool to increase their bargaining power on price, organise collective marketing and progress towards upscaling or involving themselves in the entire supply chain by setting up cooperative or farmers organisation. Similarly, Sonam and Martwanna (2011) in their studies on smallholder dairy farmers' group development in Bhutan reported that formation of smallholder dairy farmers into groups or cooperatives is found as a practicable option to develop and commercialise Bhutan's dairy sector since the majority have small farm size and limited landholdings.

A study by Williams and Hendrix (2016) on an assessment of the performance of smallholder DFGs in Bhutan showed that the unreliable, inadequate and poor-quality milk supply is a common problem threatening the economic sustainability of the groups and creating a chain of interrelated marketing weaknesses. Sonam and Martwanna (2011) also reported that DFGs in Bhutan has many challenges to be able to develop into sustainable dairy groups fully.

Milk collection, distributions and marketings are mainly done through a network of DFGs having milk collection or processing facilities in place. This is possible when individual farmers upon becoming a member of the local farmers' group supply milk regularly to the milk collection centre or processing unit

(UNDP, 2016). However, the main problems in the collection systems are inadequate, inconsistent and poor quality milk supply due to limited fresh fodder, dispersed and relatively low income from retail sales, higher ambient temperatures and inefficient milk transportation system.

According to Kunaka (2011), smallholders dairy producers, especially those located in lagging areas lack easy access to efficient logistics services hindered by long distances from the market. The study suggested that measures should be taken to improve logistics services performance in the lagging areas to enhance equal and inclusive development opportunities. This is possible by the strategic investment by the public sector, financial institutions and donor agencies along the chain functions to commit market production.

2.3.6 The role of chain supporters

Chain supporters have specific features that may be relevant for their ability to participate in value chain progression. Achchuthan and Kajananthan (2012) in their studies, stated that the stakeholders may not necessarily have direct functions in the dairy chain but can indirectly contribute to its development. These findings were complemented by other studies which argued that there is no formal public-private partnership in the value chain commodities. The government as mandated by public policy provides support to dairy farmers with livestock subsidy support packages including free research, extension services, marketing infrastructure and technical backstopping as and when required by the farmers (UNDP, 2016). Similarly, Vandecandelaere, et al. (2010) mentioned that public actors could play the leading role in the improvement of source associated products to increase their positive impact on sustainable rural progression.

A report based on studies by Sonam and Martwanna (2011) indicated that there is a mismatch of roles among the chain supporters as an implementer of the act and someone as a promoter of the groups in the field. Their studies also revealed that the absence of a uniform support program for the group mobilisation, organisational factors, competency and effectiveness of chain supporters are some of the constraints facing the business performance of DFGs and mainstreaming of value chain approach in Bhutan.

2.4 Quality milk supply

Quality refers to meeting or exceeding customer and consumer expectations (Luning and Marcelis, 2018). In this study; customer refers to the milk processor who receives milk from the suppliers. The quality of milk is a concern for the milk processor to process and market superior quality of dairy products which can be safely consumed by the consumers. Generally, milk from healthy cows contains relatively few microbial spoilage organisms. However, the bacterial load may increase rapidly through various routes such as milking environment, handlers, equipment, storage and transportation systems.

Francesconi (2007) reported that milk quality and pricing were increasingly becoming more critical in the emerging and globalising markets and indicated that cooperative experience and structure, and technique for quality grading could adversely affect the quality of milk at farm gate, as well as the costs of quality procurement and transportation.

The study conducted by Agarwal, et al. (2012) on the microbial profile of milk from household practices had reported high microbial content in the milk delivered by vendors when compared to pasteurised milk and has suggested improving the hygienic conditions along the chain with proper cold chain

facilities from milk producers to end-users. Studies by Navarro (2014) stated that even if there are high milk compositional values during milk harvesting from animals, the milk quality aspect deteriorates during transportation from farm to the processing plants. This study concluded that there is a need for harmonisation among the chain actors and supporters for milk quality improvement.

Xin-ran, et al. (2019) in their findings on factors affecting the adoption of on-farm milk safety measures in Northern China indicated that farmers adoption for raw milk safety measures is positively correlated to the farm size and suggested that change in dairy production structure towards large scale production will ensure acceptance of more raw milk safety measures. Similarly, Wangdi, et al. (2014) in their studies on the compositional quality of cows milk in Bhutan had found adulteration with water across the country which was opined to be mainly due to rinsed water of the milk container prior and after milking. The findings suggested that milk producers be made aware of the need to produce and deliver good quality to enable milk processors to produce and sell quality dairy products to consumers.

2.5 Determinants of milk supply

Milk supply is the sum of milk delivered to the processing unit, excluding the milk used for on-farm processing or consumption. According to DairyCo (2009), the main elements of annual milk supply by an individual milk supplier depends on the number of milking cows available and average yearly milk yield per cow on the farm. These findings also identified the number of replacement dairy cows available, breeding decisions, forage quality, fodder conservation practices, availability of labour, health and housing conditions of animals, and confidence of farmers in dairy farming business as the main factors affecting continued milk supply in the processing unit.

A study conducted by Lemma, et al. (2015) on determinants of supply chain coordination of milk and dairy industries in Ethiopia indicated that poor farming practices and lack of proper supply chain coordination are the main problems for sustainable dairy farming practices in the country. These findings suggest that improving dairy husbandry practices and maximising the coordination linkage along the supply chain will ensure effective and efficient dairy production and supply chain coordination.

A report based on studies by Golas (2017) indicated that the development of production capacity and supply of milk of a dairy farm has a strong correlation with an increase in milk yield, forage area and labour. The report suggested to consider the area of quality forage, number of milking cows, daily milk yield, milk prices and labour to increase milk production and supply.

2.6 The role of the business model

The business model canvas explains how an organisation creates, delivers and capture value (Osterwalder and Pigneur, 2010). The concept of this business model canvas is conceptualised into four pillars and nine elements (**Table 1**).

A study conducted by Polakova, et al. (2015) on performance implications of business model change in the Czech Republic indicated that business models played an important role in explaining the business performance of a firm and described as a strategic tool to facilitate decisions related to value creation within the business. The authors also revealed that the business model canvas depicts value creation processes within a business in a structured way, and thus allowing a comparison of the change concisely and consistently.

Table 1. Business model pillars and elements

Pillars	Elements	Explanation
The product	Value proposition	Refers to the package of products or services that create value for a particular customer segment.
The Customer	Customer segments	Explains the different groups of people or organisation an enterprise aims to reach and serve.
	Channels	Defines how a company or enterprise communicates with and reaches its customers' segment to deliver a value proposition.
	The relationships	Describes a type of relationships a company established with specific customer segments.
Infrastructure management	Key Resources	Outlines the most valuable assets required to make a business model work.
	Key activities	Defines the possessions a company or enterprise must do to make it's business model work.
	Key Partnership	Explains the network of suppliers and partners that make the business model work.
Financial aspects	Revenue streams	Characterise the cash a company generates from each customer segment.
	Cost structures	Outlines all costs incurred to operate a business model.

Source: Osterwalder and Pigneur (2010)

2.7 Chain sustainability

Sustainability is agreed as a credible and practical way to ensure social, economic and environmental conditions in dairy value chains. The study of Kuwahara, et al. (2018) on sustainability and typology of dairy production systems in Brazil claimed that differences in dairy management and production systems impose hindrances for the government and stakeholders in the production chain, and the ultimate aim of those chain supporters working towards sustainable dairy production may become ineffective. The study of Hamid, et al. (2017) also claimed that market-oriented dairy farms with a high degree of technology adoption were the most economically, socially and ecologically sustainable than those subsistence dairy farms. The authors mentioned that with increasing literacy rate, market penetration through value chain development, the sustainability of dairy production would increase. However, with scope, there is a need to link potential dairy farmers to the market by supporting in the milk value chain and also by giving focus to women empowerment to enhance competitiveness in dairy development activities.

A study conducted by Calker (2005) in the Netherlands indicated that shift towards more sustainable dairy farming systems is fundamental on the Dutch agenda for the rebuilding of the dairy production system. The report mentioned that ecological, social and economic sustainability is under pressure with the conventional way of Dutch dairy farming systems, and suggested that sustainability model needs adoption in the transition towards more sustainable dairy production systems.

The Royal Government of Bhutan (RGoB) is aware of the impacts of unsustainable agricultural practices and was one of the critical strategies for adaptation to climate change during the 11th FYP (Nowak, et al.,

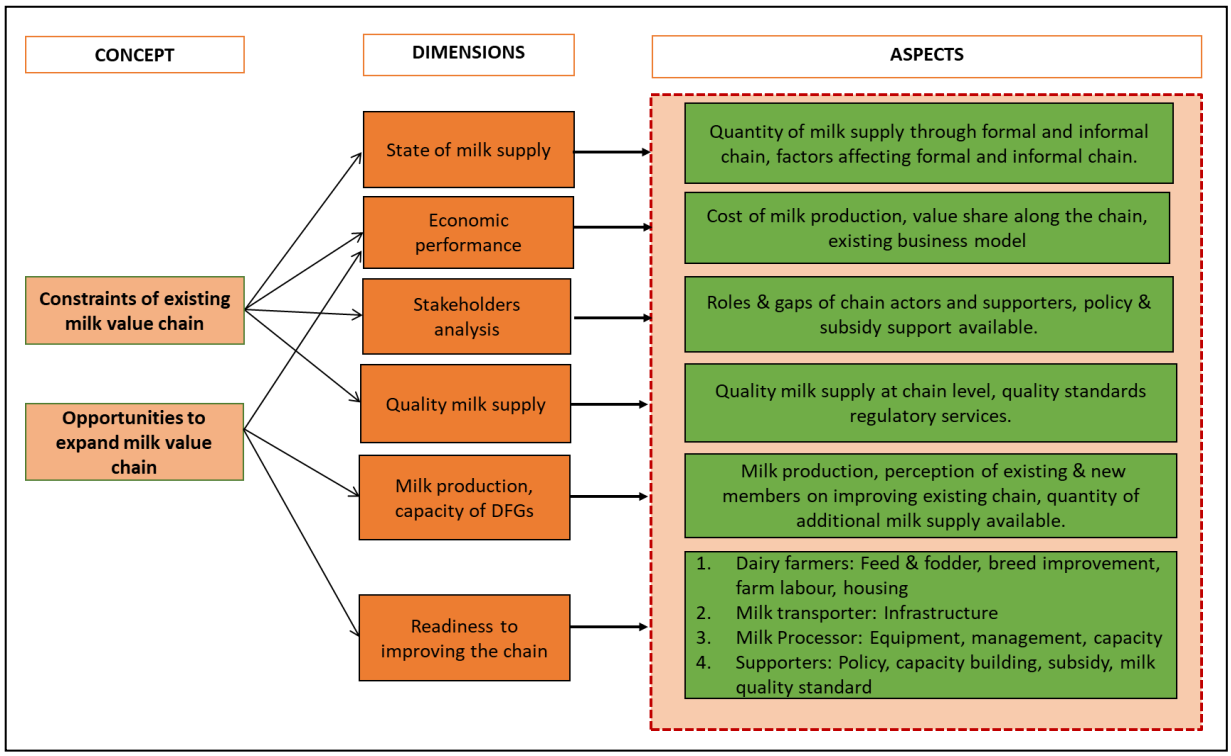
2017), and will continue to prioritize the SDGs goal 13 in 12th FYP (2018-2023) of Bhutan's pledge to the global community to remain carbon neutral for all times (GNHC, 2016). The report of Nowak, et al. (2017) also highlighted that climate-smart agricultural for livestock include cross-breeding of cattle for improved climate resilience, installation of biogas digester and integration with stall feeding system, improving animal feeding practices by producing high-quality feed, pasture and fodder development, and product diversification using energy-efficient technologies in dairy production.

The Department of Livestock during the 12th FYP has set the overall goal to "achieve livestock product self-sufficiency and self-reliant society living in harmony with nature" (DoL, 2019) and one of the programs identified for implementation is RNR Value Chain and Enterprise Development Programme which will be given due importance during the plan period. This shows that there will be studies and development of formal value chain in the country.

2.8 Conceptual framework

The conceptual framework of the study as informed by the research questions and sub-questions is presented diagrammatically in **Figure 6**. The focus of the current research was on six key dimensions; state of milk supply, economic performance, stakeholder analysis, quality milk supply, milk production trends and capacity of DFGs, and readiness of chain actors and supporters to invest in improving the existing value chain. These dimensions were further extended at aspects level to ensure that all critical elements get the desired focus while conducting the research. This framework provided that the key issues and challenges were studied and possibilities identified to expand the milk value chain in the district.

Figure 6. Conceptual framework



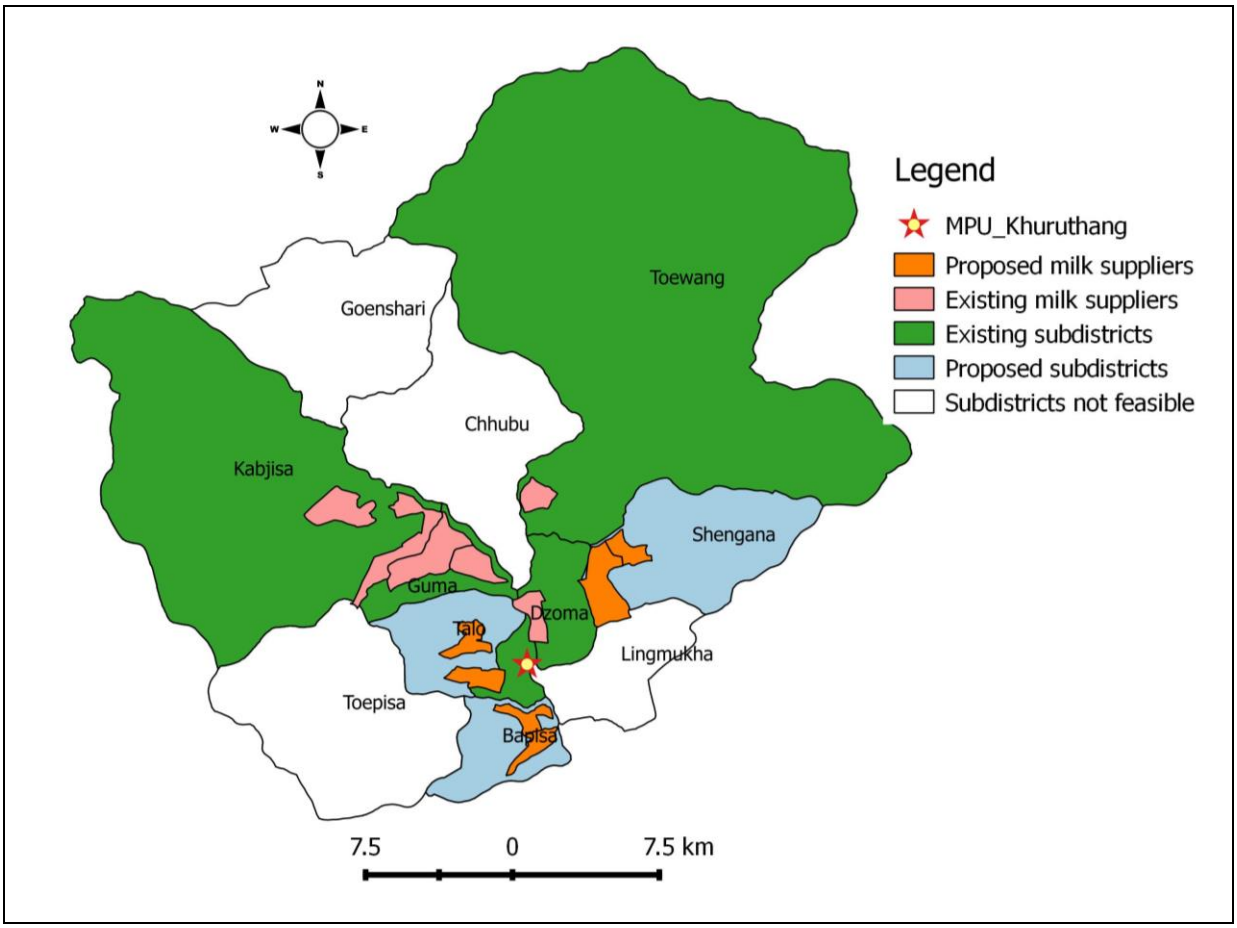
Source: Adapted from Action Research Mini Thesis (APCM, 2019)

CHAPTER III: METHODOLOGY

3.1 Description of the study area

Punakha district is located in the western part of Bhutan and stretches over an area of 1,109.81 square kilometres with an altitude of 1200–5400 meter above sea level (NSB, 2017). The district is administratively divided into eleven subdistricts, with a population of 29,391 people and 6,079 households (NSB, 2018). Punakha is famous for red rice, green chilli and fruits owing to its favourable agro-ecological zones for agriculture farming. This district is also well-known for receiving the highest number of tourists. Punakha is selected as a research area because the dairy sector is a mainstay of the livestock farming system. The favourable climatic conditions make this district most suitable for dairy compared to other districts. As indicated in **Figure 7**, the study was conducted at identified villages having organised DFGs in seven subdistricts; four existing subdistricts (Dzomi, Guma, Kabisa, Toedwang) currently supplying the milk and three new subdistricts (Barp, Shelnga-Bjemi, Talo) which are near and having potentials to deliver milk to MPU.

Figure 7. Map of the study area



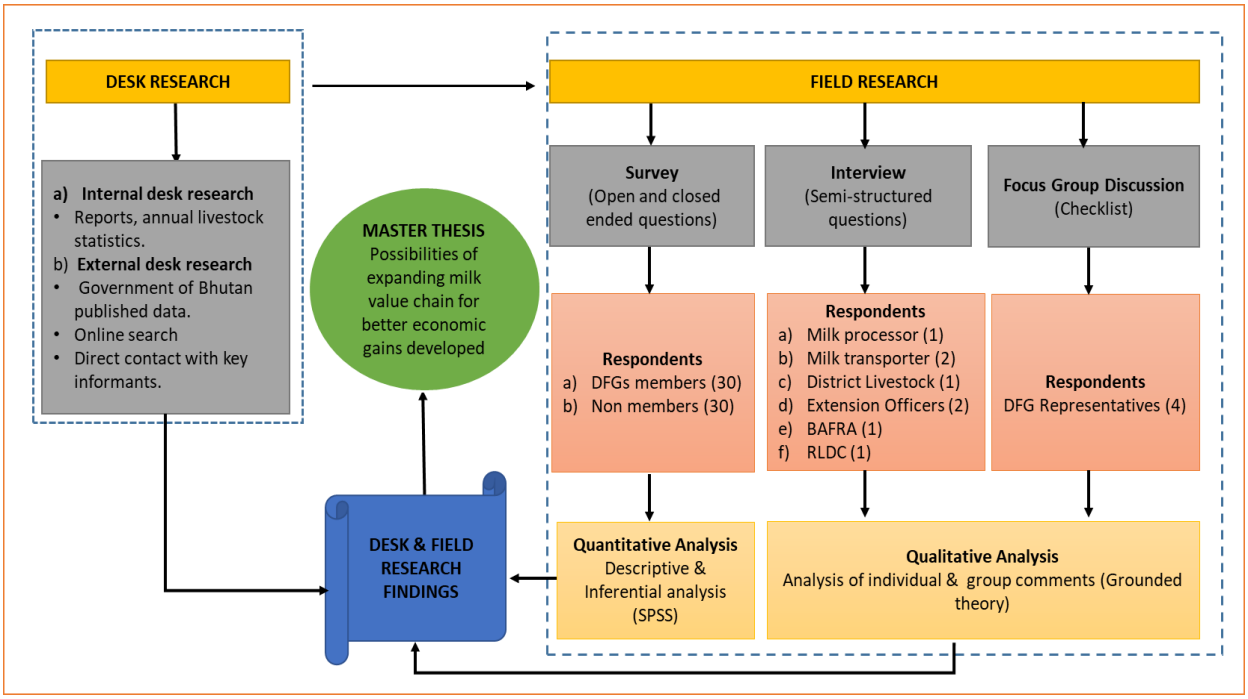
Source: Researcher sketched (Ugyen, 2019)

3.2 Research methods and sample size

The two main pillars of this study were desk research and field research. Desk research supported in identifying the knowledge gaps replicates or extend previously observed findings without involving in the original data collection. The information on milk production trends was collected through desk research.

The survey, key informant interviews and Focus Group Discussion (FGD) were used as field research strategies to obtain relevant information as per the conceptual framework designed for the study (**Figure 8**).

Figure 8. Research framework



Source: Researcher prepared (Ugyen, 2019)

3.2.1 Survey

The data were collected through a survey using both closed and open-ended structured questionnaire (**Appendix 1, pp.50-53**). The questions were prepared according to the conceptual framework designed and were used to survey milk suppliers consisting of both existing and new DFGs members. The survey questionnaire answered the four dimensions of the state of the milk value chain, quality milk supply, milk production trends and capacity, and readiness of dairy producers to invest in improving the existing chain. The content of the survey questionnaire was pre-tested with the expert view (research Supervisor) on the intention and strength of the questions developed. The course mates of APCM (Livestock Chain) 2019 were requested to review the survey questionnaire. While in Bhutan, district livestock officer (Commissioner) and two extension officers from subdistricts were requested to make the peer review of survey questionnaire developed before actual fieldwork.

A sample of 30 respondents was drawn using simple random sampling technique from 108 registered Pungdzong dairy group members currently engaged in milk supply and marketing chain from four subdistricts of Dzomi (n =6), Guma (n = 10), Kabisa (n = 9) and Toedwang (n = 5). Similarly, a total of 30 respondents out of 76 registered dairy farmers from three subdistricts of Barp (n = 11), Shelnga-Bjemi (n = 14) and Talog (n = 5). This technique had been proposed confirming each member had an equal probability of being chosen through random draws using random calculating function Microsoft Excel 2016. The top 30 samples drawn from the sampling frame were surveyed from both groups (**Figure 9**).

Figure 9. Field survey with the dairy producers

Source: Field survey (Ugyen, 2019)

3.2.2 Key Informant Interviews

One-to-one interviews were conducted following semi-structured questions **(Appendix 2, p.53-54)** to gather as much information as possible regarding all the six dimensions proposed in the conceptual framework. The conduct of these interviews with key informants assisted to collect a varied and wide range of open-ended, both qualitative and quantitative data required to identify possibilities towards increasing milk supply (**Figure 10**). Purposive sampling technique was considered to conduct key informant interviews with milk transporters, processor and supporters in the chain as mentioned in **Table 2**.

Table 2. Overview of key informant interview respondents

No/Code	Interview Date	Function of interviewee	Current Address
KI1	01/07/19	Milk transporter	Dzomi-Toedwang area
KI2	01/07/19	Milk transporter	Guma-Kabisa area
KI3	01/07/19	Processor	MPU - Khuruthang
KI4	02/07/19	Livestock Extension Officer	Toedwang
KI5	02/07/19	Livestock Extension Officer	Kabisa
KI6	08/07/19	District Livestock Officer	Punakha
KI7	02/07/19	Head of Livestock Regulatory Unit	BAFRA, Punakha
KI8	28/07/19	Head of Feed & Fodder Unit	RLDC, Wangdue

Source: Researcher prepared (Ugyen, 2019)

Figure 10. Key informant interviews with chain actors and supporters

Source: Key informant interviews (Ugyen, 2019)

3.2.3 Focus group discussion

One group discussion (focus group) was initiated between the representatives of existing DFG having similar characteristics or experiences (**Figure 11**). The purposive sampling technique was applied to select five DFG representatives for FGD.

It was aimed to discover in-depth information about how groups think about expanding the milk value chain in the district and triangulate on varying information gathered during the survey and key informant interviews. Thus, focus group discussion was organised using checklist questions (**Appendix 3, p. 55**) after completion of survey and interviews and shared results of the survey and key informant interviews for further triangulation.

Figure 11. Focus group discussion with DFGs representatives

Source: Focus Group Discussion (Ugyen, 2019)

3.3 Data Analysis

3.3.1 Quantitative data

The data collected from the survey was computed using MS Microsoft Office Professional Excel 2016, and the coded data were analysed using Statistical Package for Social Sciences (SPSS) IBM statistics version 20. Both descriptive (mean, proportion, crosstab) and inferential (Chi-square) statistics were used to analyse the data. Simple bar graph, pie charts and contingency tables were used where appropriate to interpret and present the survey findings.

3.3.2 Qualitative data

A method of grounded theory design was used to analyse the qualitative data of interviews and focus group discussion following five logical steps of organising data in fragments, determining the relevance, open coding, axial coding and selective coding (Baarda, 2014). The findings of grounded theory were organised around the key dimensions identified in the conceptual framework. Some of the findings of grounded theory have been presented in a matrix.

3.3.3 Other analytical tools

This study had used simple value chain mapping adapted from APCM (2018) to chart existing and future milk value chain in the district. Through this chain mapping, there will be a clear understanding of the various actors, supporters and facilitators involved, value share and market forces for the milk business. The study also used the Business Model Canvas tool adapted from Osterwalder & Pigneur (2010) framework to analyse existing and create a new business model for the milk processor. A combination of SWOT-PEST model was used to understand and present the factors affecting the expansion of the milk value chain in the district.

CHAPTER IV: RESULTS

4.1 Socio-demographic information of the study area

The socio-demographic information of the respondents is presented in **Table 3**. From the total respondents interviewed (n = 60), 16 were male and 44 female respondents. The mean age of respondents in DFGs was 51.70 years and 53.53 years for non-DFGs indicating the respondent selection was within the same age range. Majority of the respondents were illiterate with exceptionally some respondents having a primary and secondary level of education. The household family labour ranged between one to six members and farming land between 0.25 acres to 6.30 acres.

Table 3. Socio-demographic information of the study area

Variable	Groups	Male	Female	Total
No. of respondents	DFGs	6	24	30
	Non-DFGs	10	20	30
	Total	***16***	***44***	***60***
Variable	**Groups**	**Level of education**		
		Illiterate	**Primary**	**Above secondary**
Educational background	DFGs	23	7	0
	Non-DFGs	21	6	3
	Total	***44***	***13***	***3***
Variable	**Groups**	**Mean**	**Minimum**	**Maximum**
Age of respondents (Years)	DFGs	51.70	26	80
	Non-DFGs	53.53	32	78
Household family labour (Nos.)	DFGs	2.97	1	6
	Non-DFGs	2.37	1	5
Farmland (Acres)	DFGs	2.02	0.25	5.00
	Non-DFGs	2.64	0.50	6.30

Source: Survey data (Ugyen, 2019)

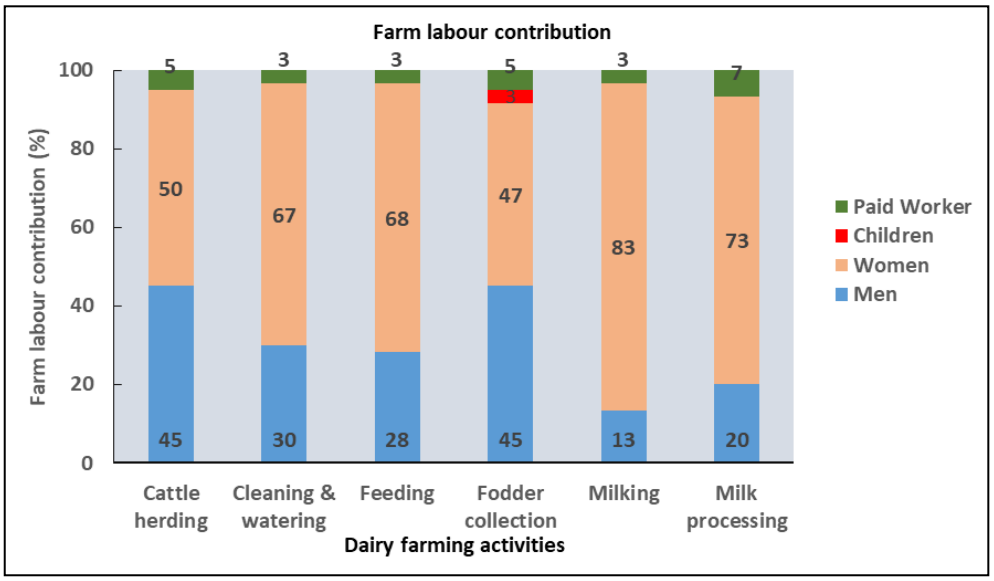
4.2 Dairy management system

To assess and quantify the dairy management system in the study areas, data's pertaining to cattle holding, milking cow, housing, feeds and feeding, and grazing system were collected and analysed.

4.2.1 Household farm labour contribution

Figure 12 presents the respondents' views on farm labour contribution to dairy farming activities. Overall, women have a major contribution in all areas of dairy farming activities such as cattle herding, cleaning of sheds, feeding, fodder collection, milking and processing of milk into butter and cheese. Among the 60 respondents, it was reported that the work of cattle herding is mostly done by women (50%). The dairy producers in this study area rarely use their children and hired farm labour in dairy farming activities.

Figure 12. Percentage of household farm labour contribution (n = 60)



Source: Survey data (Ugyen, 2019)

4.2.2 Cattle population and milk production

The finding reveals that the Non-DFGs had a maximum number of cattle holding (8.53 ± 4.99) in comparison to DFGs with 5.70 ± 3.14 number of cattle (**Table 4**). However, DFGs had a maximum number of improved cattle breeds of 4.80 ± 3.14 cattle when compared to Non-DFGs of 4.40 ± 3.45 number of cattle. The finding also shows that the total daily milk production per household was higher in DFGs which was found to be 12.23 ± 7.89 litres in comparison to 8.75 ± .5.09 litres in Non-DFGs. Similarly, the mean daily milk production per cow was higher in DFGs which was estimated at 6.25 litres when compared to 3.60 litres in Non-DFGs.

Table 4. Cattle population and milk production in the study area

Variable	Groups	Mean	SD	Minimum	Maximum
Local cattle holding (Nos.)	DFGs	0.90	2.14	0	10
	Non-DFGs	4.13	5.13	0	16
Improved cattle holding (Nos.)	DFGs	4.80	2.34	1	11
	Non-DFGs	4.40	3.45	0	16
Total cattle holding (Nos.)	DFGs	5.70	3.14	1	16
	Non-DFGs	8.53	4.99	3	19
Milking cows (Nos.)	DFGs	2.07	0.83	1	4
	Non-DFGs	2.43	1.46	1	6
Morning milk production per household (Litres)	DFGs	7.53	4.87	3.50	22.00
	Non-DFGs	5.23	3.40	0.50	15.00
Evening milk production per household (Litres)	DFGs	4.70	3.08	0.00	12.00
	Non-DFGs	3.51	2.14	0.00	8.00
Daily total milk production per household (Litres)	DFGs	12.23	7.89	5.00	34.00
	Non-DFGs	8.75	5.03	1.00	23.00

Source: Survey data (Ugyen, 2019)

4.2.3 Cattle housing and management system

Cattle housing differed within the study areas as illustrated in **Table 5**. The result showed the majority (70%) of respondents had permanent shed over the temporary shed. A day-out night-in cattle rearing system is predominant (72%) over the stall-feeding system.

Table 5. Number of respondents with the different cattle housing and management system

Variable	Type	DFGs	Non-DFGs	Total
Cattle shed	Permanent shed	23	19	42 (70%)
	Temporary shed	7	11	18 (30%)
	Total	***30***	***30***	***60 (100%)***
Management system	Stall feeding	9	8	17 (28%)
	Day-out night-in	21	22	43 (72%)
	Total	**30**	**30**	**60 (100%)**

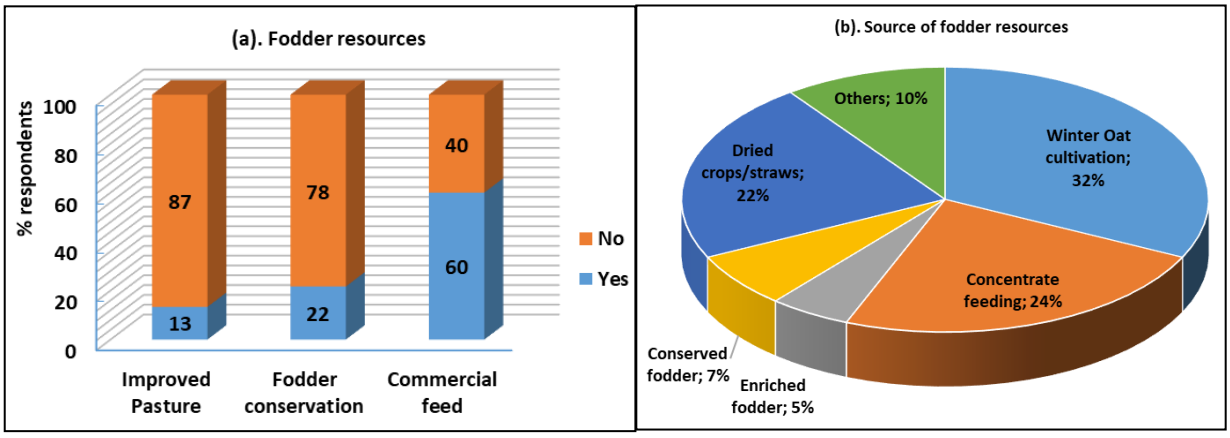
Source: Survey data (Ugyen, 2019)

4.2.4 Availability of fodder resources and source

The detail reports on the availability of feed and fodder resources in the study area are shown in **Figure 13(a)**. The result showed the majority (87%) of the respondents do not have improved pasture developed. Further, the area of landholding under improved pastureland was only 0.44 ± 0.63 acres per household.

To overcome this problem, the farmers are dependent on different sources of feed and fodder resources as indicated in **Figure 13(b)**. By proportion, the maximum feed resource comes from winter oat cultivation and the minimum from enriched fodder and others which is inclusive of vegetables, beverage residues and tree fodder.

Figure 13. Availability of fodder resources and their sources (n = 60)

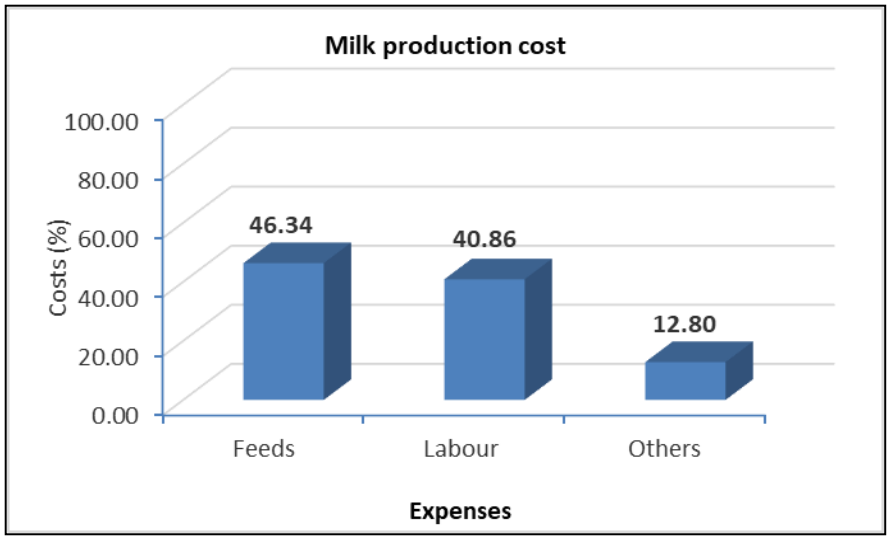


Source: Survey data (Ugyen, 2019)

4.3 Cost of producing milk

The maximum milk production expenses were incurred in animal feeds (46.34%) and minimum (12.80%) for the cost of other expenses that includes depreciation and maintenance of dairy sheds, and interest of herd value (**Figure 14**). The COP was estimated at Nu.27.53 per litre milk in the study area (**Appendix 4, p. 55**).

Figure 14. Distribution of milk production costs



Source: Interview respondents, FGD & Desk Review (Ugyen, 2019)

4.4 Factor influencing the formal and informal milk market

The survey result shows that none of the existing milk suppliers was involved in the informal milk marketing which was further corroborated through FGD. When asked what were the determinants of formal and informal milk marketing, consultation brought about valuable information as follows.

In terms of the formal milk market, they agreed that the government supports more for DFGs than an individual farmer in all areas of livestock development activities. The main area of support was on supply of seeds and seedlings for fodder development, subsidy support for cattle sourcing, shed construction and buying of dairy equipment and machinery. This was corroborated through KI6 who mentioned that *"dairy, egg and meat are three priority commodities identified by the Department of Livestock for cost-sharing support mechanism during the 12th FYP and actors involved in the production, processing and marketing share the costs involved"*. In addition, FGD accepted the advantage of not having to process the milk at the farm level which is the main problem at the moment.

KI3 and FGD claimed the influence of premium milk pricing for choosing informal milk marketing by some individuals. It was learnt that some farmers choose to be individualistic as they get a premium price when delivered in high-end resorts and hotels. According to KI5, a progressive dairy farmer in Kabisa subdistrict deliver 5-10 litres of milk at Uma resort and receives Nu.70 per litre of milk.

4.5 Determinants of milk quality supply

4.5.1 Milk harvesting and supply

This study aimed to assess the views of dairy producers on hygienic and quality milk supply to MPU. As illustrated in **Figure 15**, the majority responded that they always clean the milking utensils, cow udder and milkman's hands before milking. However, with regard to the use of a towel to dry the udder after cleaning with water, the majority (58%) of the respondents reported that they never use the towel to dry the udder after cleaning with water and before milking.

When asked about the quality of milk supplied by dairy producers, KI1 and KI2 mentioned that majority of the dairy producers are aware of the requirement for quality milk delivery, however, some farmers are still reluctant to cooperate for the quality milk supply. They also mentioned that without proper milk collection sheds, they have the problem of maintaining milk quality, especially during peak rainy season. An in-depth interview with the informants provided an explanation on how they support quality milk production and supply, presented in Box 1.

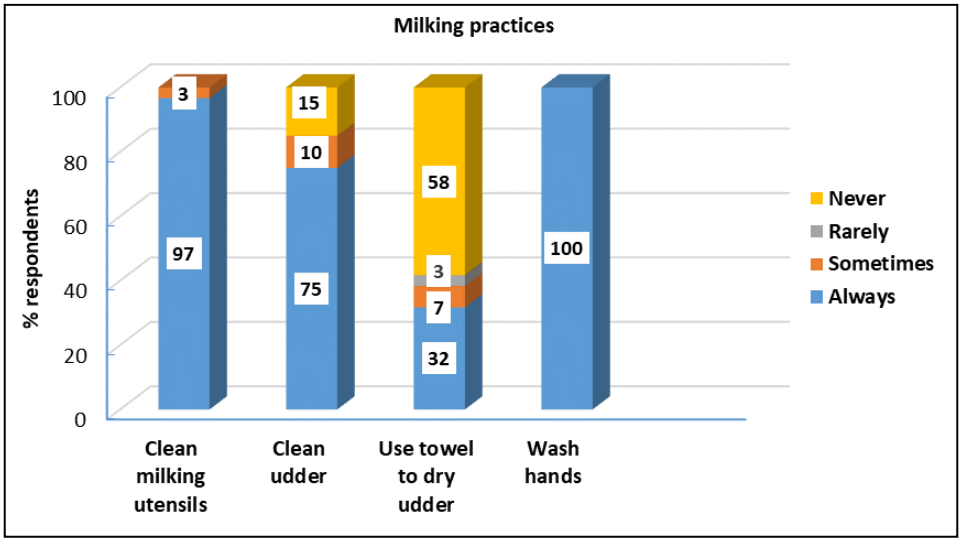
Box 1: Two example of support services influencing the quality milk supply in formal market

The first explanation was provided by KI7. He informed that BAFRA Office based in Khuruthang regularly conduct random milk quality tests in both formal and informal market using milk adulteration test kit and lactoscan. The test date 15/7/2019 confirmed the presence of mastitis infected milk for the milk collected from Dzomi-Toedwang subdistricts.

Similarly, KI5 and KI6 explained that extension offices in the subdistricts had conducted an awareness training to dairy farmers and the adoption rate on clean milk production and supply practices should be increasing.

The KI7 observed that consumers perception towards dairy products sold from this formal marketing system is good compared to those that are sold informally by individual farmers. However, there was no consensus among the informants regarding the question “quality milk supply”.

Figure 15. Practices on quality milk production and supply (n = 60)



Source: Survey data (Ugyen, 2019)

4.6.2 Utensils used and walking distance to the nearest MCP

The result is related to the type of utensils used while delivering the milk in the collection point (**Table 6**). The result shows that 19 (63%) respondents used a plastic container with lid, while 11 (37%) respondents claimed of using either aluminium or stainless-steel container for delivering milk to MCP**.** This finding was corroborated through KI2 who stated that majority of the farmers use a plastic container to deliver milk at the collection point.

When questioned about the distance from the farm to the nearest MCP, Majority (77%) responded their farms were located within 5 minutes walking distance away from the MCP.

Table 6. Number of respondents on milk utensils used and distance from farm to MCP

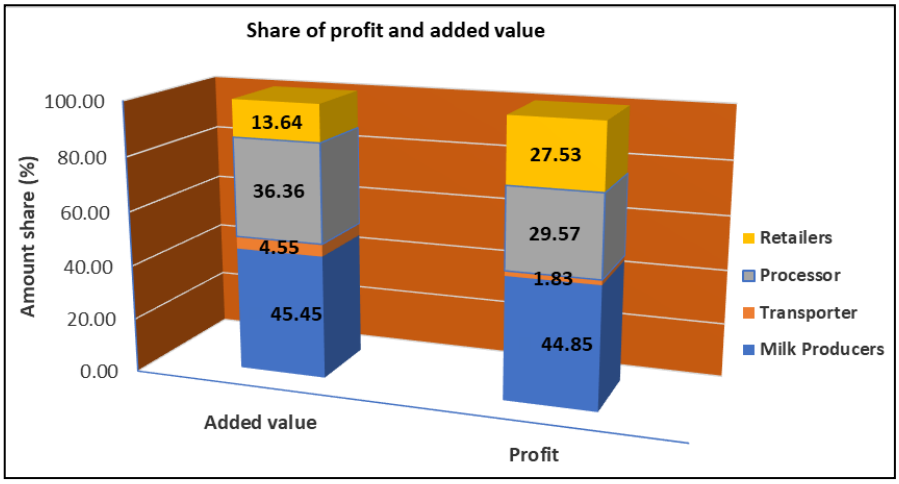
Variables	**Plastics container with lid**	**Plastic container without a lid**	**Aluminium/ Stainless steel**	**Others (wooden, glass)**	**Total**
Utensils used	19	0	11	0	30
Variables	**<5 minutes**	**6-10 minutes**	**11-20 minutes**	**>21 minutes**	
Distance from farm to MCP	23	2	5	0	30

Source: Survey data (Ugyen, 2019)

4.7 Economic performance of the milk value chain

Figure 16 illustrates the distribution of profit and added value share among the chain actors in the milk value chain. This value chain is a typical chain in which the milk producers lead the chain forward and the majority (45.45%) of the added value of the chain is captured by the milk producers. The result also shows that milk producers receive the largest share (44.85%) of the profit, while the milk transporters get the marginal profit of only 1.83% of the total profit made in the chain. The detailed calculation of profit share and added value is presented in **Appendix 5, p. 55**.

Figure 16. Distribution of profit and added value in the existing value chain



Source: Interview respondents and DLS (Ugyen, 2019)

4.8 Gap analysis of stakeholders in the formal milk market

The institutional framework of different respondents was identified and analysed according to chain functions and their supporting roles in the functioning of the milk value chain in the district. The study found that fresh milk supply and marketing activity is new in the study area and there are overlapping functions in carrying out milk value chain activities. Limited information and coordination amongst stakeholders have contributed to slow progression in the milk supply and marketing chain.

What was revealed from the key informant interview is that there are poor linkages between the stakeholders in the chain. KI4 mentioned that there are poor linkages between stakeholders, every chain actors and supporters focusing only on their own chain function and do not know what is happening across the chain. KI7 also agreed on this statement and informed that as a regulatory authority, they are tasked on ensuring quality standards of dairy products in the market and yet don't know the plans and policies of other stakeholders in the chain. Poor stakeholder linkages were also raised during FGD. Many respondents also agreed that there is limited participation from local government in this chain although they were instituted to support the active participation of people in their own development. All the key informants interviewed agreed on not having even a single stakeholder meeting conducted regarding milk value chain in the district.

The summary of existing roles and gaps of chain actors and supporters from the eight key informants interview conducted are presented in **Table 7**.

Table 7. Stakeholders analysis for the milk value chain in Punakha district

Stakeholders	Key Roles	Supporting forces to expand the milk value chain	Hindering forces to expand the milk value chain
Dairy producers	▪ Fresh milk production and delivery	▪ Trained farmers on milk production and quality control. ▪ Strong Government support to DFGs	▪ Limited landholding for feed and fodder development. ▪ Low yielding dairy cattle. ▪ Difficulty in land leasing.
Milk transporters	▪ Milk collection and transportation	▪ A reliable source of income	▪ Insufficient milk collection particularly during winter ▪ Late delivery of milk at the collection point by dairy producers. ▪ Less profitable during winter because of high transportation costs and less milk collection. ▪ Difficulty in maintaining milk quality especially during the rainy season without the proper milk collection sheds.
Processor	▪ Milk bulking, processing, packaging and sales	▪ Income and employment opportunities. ▪ Trade policy and regulation	▪ Insufficient milk supply ▪ Inconsistent milk supply
District/Extension Officer (subdistrict)	▪ Provide livestock extension, animal health services and capacity development	▪ Clearly defined roles, functions and institutional setup (DoL, 2016) ▪ Aligned in 12th FYP documents at the district level.	▪ Fewer linkages between the chain actors and supporters. ▪ Lack of technical expertise on the milk value chain and product diversification. ▪ Limited landholding for dairy farmers to facilitate improved fodder development.
RLDC	▪ Post-production and marketing activities	▪ Clearly defined roles, functions and institutional setup (DoL, 2016). ▪ Aligned in 12th FYP documents at a regional level.	▪ Limited approved budget to perform post-production activities in the region. ▪ Poor marketing system in place (congesting the already limited market place by competing on similar products between the DFGs in the region).
BAFRA	▪ Quality control and food safety measures	▪ Food rules and regulation of Bhutan 2017	▪ Limited manpower to conduct the frequent regulatory check. ▪ Limited budget to conduct milk quality standards and educational program for the chain actors.

Source: Survey data, key informants' interview & FGD (Ugyen, 2019)

4.9 Opportunities towards increased milk supply

4.9.1 The readiness of Non-DFGs in the formal milk market

Contingency table showing the Non-DFGs respondents' problem in selling fresh milk and their interest in joining the formal milk market is shown in **Table 8**. Statistically, the result showed a significant correlation between the problem in selling fresh milk and their interest in joining the formal milk market, χ^2 (1) = 6.00, p = 0.01 (**Appendix 6, p. 56**). Among 30 respondents; 25 respondents had reported having a problem in selling fresh milk and the other 5 respondents mentioned having no problem in selling fresh milk. When asked about respondents' interest in joining the formal milk market, 27 (90%) respondents show interest in joining formal milk marketing with Pungdzong DFGs, while 3 respondents have no interest in joining formal milk marketing.

The study showed that the daily average morning milk available for supply by each household was 4.41 ± 3.07 litres of milk. The total quantity of milk available was estimated at 119 litres ranging from 0.5 litres to 15 litres at the maximum from each household.

Table 8. Contingency table showing the interest and morning milk for supply by Non-DFGs

	Interest in joining the formal milk market (n = 30)		
The problem in selling fresh milk	**Yes**	**No**	**Total**
Problem in selling fresh milk	24	1	**25**
No problem in selling fresh milk	3	2	**5**
Total	**27**	**3**	**30**

Particulars	**Morning milk available for supply (Litres)**			
	Average milk supply	***Minimum***	***Maximum***	***Total***
Morning milk	4.41 ± 3.07	0.50	15.00	119.00

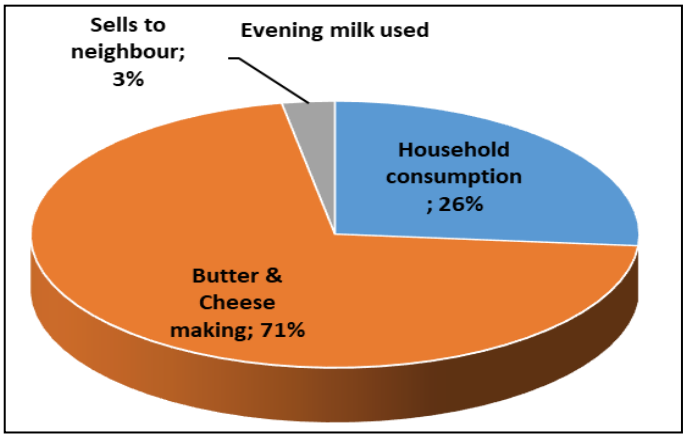
Source: Survey data (Ugyen, 2019)

4.9.2 Readiness in supplying evening milk

The respondents from both DFGs and Non-DFGs were asked how they were managing with evening milk and their readiness to supply if MPU is willing to collect from them. As indicated in **Figure 17**, the respondents reported that 71% of the evening milk produced is processed into butter and cheese, while 26% of evening milk is being used for household consumption as fresh milk and preparing butter tea, the other 3% is being sold to their neighbour.

Similarly, the respondents from both DFGs and Non-DFGs were questioned if they were willing to supply evening milk to MPU. The study found that 50% of the respondents were interested in supplying evening milk. The daily average evening milk available for supply was 4.43 ± 2.25 litres from each household (**Appendix 7, p. 56**). The total quantity of evening milk available was estimated as 133 litres ranging from 1 litre to 10 litres at the maximum from each household.

Figure 17. The proportion of evening milk usage (n = 60)

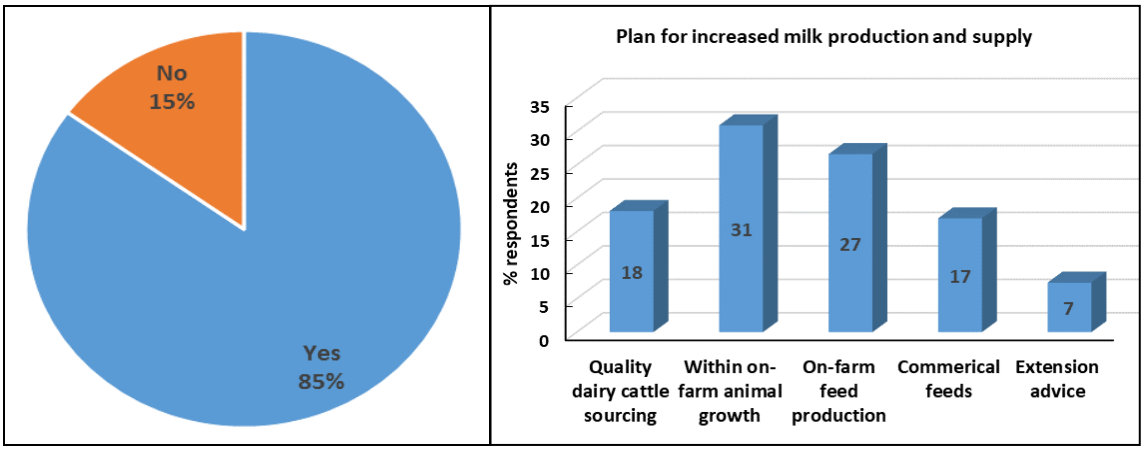


Source: Survey data (Ugyen, 2019)

4.9.3 The readiness of dairy producers towards increased milk production and supply

The study looked into the readiness of dairy producers in increasing their production capacity to meet the existing processing plant capacity. It was found that 85% of the respondents were ready to increase their milk production capacity (**Figure 18**) through one or more of the dairy farming activities; sourcing of good quality dairy cows, growth from within farm through breed improvement program, production of more on-farm animal feeds, purchase of commercial feeds, dependency on extension advice. By proportion, the maximum outcome of 31% will rely on on-farm growth of high yielding dairy cattle and the minimum (7%) through timely extension advice and supports.

Figure 18. The proportion of respondents plans towards increased production and supply (n = 60)



Source: Survey data (Ugyen, 2019)

4.9.4 The readiness of supporters in expanding milk supply

The approach towards mainstreaming milk value chain is on transition recognizing the benefits that the development tools provide in increased milk production in the district.

4.9.4.1 Support for feed and fodder development

Most interviewees revealed that insufficient feed and fodder is a limiting factor for increased milk production and supply due to less landholding with the dairy farmers [KI3, KI4, KI5, KI6 & KI8]. KI5 & KI6 stated that with the recent policy change by National Land Commission of Bhutan, dairy farmers will have an opportunity to lease state reserved forest land for Tsamdro (pasture) to enhance feed and fodder requirement. KI6 also stated that the district livestock sector will be vigorously working with dairy farmers to lease the state land for pasture development in the district. However, the preference for leasing land will be given to proponent based on the number of livestock unit owned and Tsamdro management plan proposed by the applicant. KI5 agreed that farmers are eligible to lease state reserved forest land for pasture development and opined that this program will increase the quantity and quality of feed resources.

KI8 elaborated that RLDC is also trying to introduce legume forage production enterprise to enrich protein requirement in animal feeds. It was stated that the program has been introduced in one of the districts and will start in other four districts including Punakha during the FY 2019-20.

4.9.4.2 Support for intensification of dairy cattle breed

Key informant interviewees were also given an opportunity to express their thoughts on other areas of intervention and strategies that they are ready to implement for increased milk production and supply in the district. Many informants shared that breed improvement program should be considered as an influential factor for increased milk yield. KI4 mentioned that many subdistricts have started Contract Heifer and Bull Production Program (CHBPP) since 2015 wherein CHBPP registered dairy animals are inseminated with imported semen of superior quality breeding bulls. The presence of CHBPP activities in the subdistrict was corroborated by KI5 who stated that “Not every household have CHBPP progenies but those households benefiting from this program has more than 3 female progenies which will enhance increased milk supply in one or two years from now”.

KI6 elaborated that the current strength of dairy animals available in the subdistricts are not able to meet the sectoral APA target of increased milk production. The sector will be focusing on accelerating AI program in all 11 subdistricts wherein this program will help enrich milk production and supply in the district. KI5 and KI6 also stressed on initiating dairy cattle sourcing through subsidy support package in 12^{th} FYP.

4.9.4.3 Support for DFGs expansion

Respondent [KI4] mentioned that smallholder DFGs are vital towards the expansion of milk supply in MPU. It was revealed that there are many farmers having high yielding dairy cows and interested in group formation which will support MPU in scaling up the daily milk collection. It is not exactly clear what hinders them from not joining the group from the initial stage, but most of the key informants believe that these farmers use “wait and see” strategy to gain confidence in joining the group by judging the performance of the existing dairy farmers group activities [KI4 & KI5]. The livestock extension offices are vigorously trying to help the farmers in the formation and development of mutually trusted dairy groups. KI6 substantiated by stating that the livestock sector will initiate formal registration of Pungdzong DFG with DAMC as one of the instruments for modernisation and commercialisation by assisting in production, collection, processing and marketing.

4.10 SWOT-PEST analysis of current milk value chain

In this study, the strategic analysis tools of SWOT (Strengths, Weaknesses, Opportunities, and Threats)-PEST (Political, Economic, Social and Technological) model have been used to explore the constraints and opportunities in expanding milk value chain in the district (**Table 9**).

Table 9. SWOT-PEST analysis matrix

SWOT-PEST Model		*Political*	*Economic*	*Social*	*Technological*
Internal factors	***Strength***	- National policy support on the dairy development program. - Sector development funds are devolved to Local Government.	- Tourist destination. - Many high-end hotels, resorts.	- Incremental trends towards dairy commercialisation. - Easy access to road and transport.	-Rapid progress in processing technology.
	Weakness	- Difficulty in leasing state-owned land for pasture development. - Mortgaging for a loan an issue for small-scale dairy farmers.	- The high price of raw materials (milk). -Seasonality of milk production, thus, reducing plant capacity utilisation.	- Small farm size. -Subsistence farming. - Some dairy farmers have "wait and see" mindsets.	- The poor performance of dairy cows. - Limited advancement in milk harvesting and transportation.
External factors	***Opportunities***	- Strong policy support from the government - Priority sector lending loan scheme for small-scale dairy farmers.	- Milk self-sufficiency shortfall by over 37% as of 2018. - No other similar business in the district. - Increase in purchasing power of consumers.	- Inclination towards western diets (dairy). - Rising incomes, urbanisation and cultural curiosity.	- Favourable climatic conditions. - Advancement in milk harvesting (milking machine) and transportation (Freezer Van).
	Threats	- Imported milk and milk products - Diseases outbreak (prevalence and incidences) due to the impact of climate change.	- Increasing concentrate feed cost. - Stiff competition from the Indian products.	- Slow development of formal milk market and cold chain distribution system.	- No sufficiently trained personnel for modern dairy operations.

Source: Survey data and informant interviews (Ugyen, 2019)

4.11 Business Model Canvas

The business environment of the MPU is presented in **Table 10** (see **Appendix 8, p. 56** for detailed calculation). The existing business environment of MPU was assessed based on its accessibility to inputs, labour, time and resources. The study revealed that the current business model lacks some aspects of key activities, resources and partnership efficiency especially on quantity and quality of milk supplied in the MPU.

Table 10. The existing business model canvas of MPU

<table>
<tr>
<td rowspan="2">8. Key Partners
• DFGs members
• Milk transporters
• Livestock sector
• BAFRA
• RLDC
Limitation: Poor coordination/ partnership among the chain actors and supporters.</td>
<td>6. Key Activities
• Processing and packaging of milk and milk products
• Quality assessment of raw milk delivered
• Product distribution and marketing
Limitation: Inconsistency in the quantity and quality of dairy products marketed</td>
<td rowspan="2">1. Value Proposition
• Fresh milk
• Good quality
• Competitive market price
• Products (set yoghurt, curd)

Limitations: Insufficient milk for product diversifications</td>
<td>4. Customer Relationships
• Timely delivery of products.
• Fair pricing
• Communication/ feedback
• Mutual trust/loyalty</td>
<td rowspan="2">2. Customer Segments
• Retail shops
• Hotels & Restaurants
• Schools
• Institutions</td>
</tr>
<tr>
<td>7. Key Resources
• Milk
• Skilled personnel
• MPU (rented gov. building)
• Dairy equipment (leased)
• Marketing Van
Limitation: Insufficient milk supply.</td>
<td>3. Channels
• MPU shops
• Doorstep supplies
• Exhibition/cultural events
• Retail agents</td>
</tr>
<tr>
<td colspan="2">5.Cost Structure (Nu. 7.02 million)
• Variable costs: Nu.6.25 million
Raw milk, yoghurt cups, starter culture, bottles, electricity, processing and marketing costs.
• Fixed costs: Nu. 0.77 million
Rental charge, staff salaries, depreciation, interest, maintenance cost.</td>
<td colspan="3">9. Revenue Stream (Nu. 8.15 million)
• Fresh milk @ Nu. 1.58 million (19.39% of the revenue)
• Processed dairy products @ Nu. 6.57 million (80.61% of the revenue)</td>
</tr>
<tr>
<td colspan="5">10. Social and Environment Benefit
• People: Healthier products, empowerment of small-scale dairy producer and contributing to household income generation
• Profit: Continues the source of income for chain actors.
• Planet: Reduced farm level processing, rearing of high yielding dairy cows)</td>
</tr>
</table>

Source: Adapted from APCM Project Management Assignment (Ugyen et.al., 2019)

CHAPTER V: DISCUSSIONS

This section is devoted to providing a critical discussion of the study findings when setting against the literature review as discussed in chapter two to argue emanating issues. The overall aim of this study was to find out the possibilities of expanding the milk value chain in Punakha district, therefore the discussion paper is organised according to the research questions.

5.1 Formal and informal milk value chain

In the first sub-question, the researcher had assumed that there is both formal and informal milk marketing, after conducting research it is viable to question why some dairy farmers are opting informal milk market over the formal marketing. In this study, the sale of fresh milk is done mostly through formal milk marketing through a network of DFGs supplying milk on a regular basis to the MPU. The percentage share of formal milk collection was comparatively higher than the informal channel. This result contradicts with the findings of UNDP (2016) who mentioned that only a small portion of the milk produced in Bhutan is distributed through the formal sector. Similarly, Leksmono, et al. (2006) reported that the informal sector dominates the marketing of raw milk to consumers. Sonam and Martwanna (2011) revealed the advantages of formal milk marketing by earning a regular cash income besides strengthening the financial position and social bond among the DFG members. The present study reveals that many milk producers prefer formal milk marketing instead of the informal distribution system as dairy farmers experienced informal channel being inefficient because of irregular consumer demands and not being able to sell surplus milk.

What becomes clear from result section 4.4 is that some farmers choose to be individualistic as they get a premium price when delivered in high-end resorts and hotels. Milk producers who continue to choose informal distribution systems reasoned the benefit of premium milk pricing. These results go beyond the report of Ishaq, et al. (2016) showing that the choice of milk marketing system is influenced by socio-economic determinants. It should be noted that the existence of both formal and informal milk marketing chain shows the vitality of the dairy sector in the district and allows smallholder dairy producers to be included in the formal milk market without making a major investment.

5.2 Quality milk supply

An important factor that explains the expansion of milk value chains are production and supply of quality milk. This section captured the understanding of how milk quality is perceived and communicated by actors along the chain. It was explained in the literature review that quality refers to meeting or exceeding customer and consumer expectations (Luning and Marcelis, 2018). The positive aspects observed from this study is that the majority of the milk producers follows proper milk techniques; cleaning milking utensils, washing of udder and hands before milking. However, milk producers rarely use a towel to dry off the water after washing the udder which is a very crucial aspect related to milk quality such as prevention from adulteration with water and to reduce microbial contamination. It should also be noted that milking of a cow in a holding area with wet or dusty manure may contribute towards quality milk deterioration.

One of the determinants for quality milk supply is the type of utensils used to deliver milk and farm distance to the nearest MCP. In this study, the majority of the milk producers used a plastic container which influences the quality of milk delivered. The findings are directly in line with previous findings of Penjor and Gyeltshen (2018) who found high contamination and microbial growth in the milk packed

and transported in jerry cans. However, the farm distance to the nearest MCP was found to be less than 20 minutes walking distance which is very sensible to keep the collected milk under control as milk transporter was able to deliver within two hours of collection to MPU.

Since milk quality is all about avoiding quality deterioration from production to final sale to consumers, quality control should occur at every step in the production and supply chain. Keskin and Gulsunoglu (2012) stress that milk quality is all about prevention on each step of production. The processor has to meet the consumer demands of safe and wholesome dairy products that can be purchased without any doubt. This is a clear knowledge gap regarding quality milk harvesting and supply and could serve as a basis to initiate an educational program in improving milk quality standards for better processor competitiveness in the market. Structuring of milk collection sheds at strategic locations may be an important link between producers and processor for quality milk supply. It is also necessary to fix the payment for milk based on quality to encourage hygienic milk production and supply performance (Navarro, 2014; Penjor and Gyeltshen, 2018). Milk processor can apply similar intervention strategies of paying bonuses to the dairy producers for delivering high-quality milk without affecting the existing milk price.

5.3 Economic performance of the milk value chain

The COP of milk in this study was found to be higher compared to the findings of Kaur, et al. (2012) who reported COP in various zones of Punjab in India to be Nu.14.29 in comparison to Nu.27.53 per litre milk in this study The variable costs shared the majority of the total production costs and are similar to the findings of Kaur, et al. (2012) and Kumawat, et al. (2014). However, the results obtained by the Bureau for Rural Sociology and Agriculture (2018) reported high milk production costs in six important milk-producing countries of Europe which was estimated at euro cents 38.74 to 45.14. It is quite complex to compare the milk COP and economic performance of the milk value chain. There is variation in calculating the COP of milk from one producer area to the next and mainly depends on costs and availability of resources to manage the dairy farming. Majority of the dairy farmers free their animals for grazing during the day time and bring them back in the evening and has no idea on the amount of forage intake while grazing. However, Chophyel (2009) reported that free grazing dairy cows will have maximum dry matter intake of 8 kgs which is near to the green fodder intake presumption made in this study.

According to our results section 4.7, the milk producer is leading the chain with a maximum share of profit. Meanwhile, milk processor who has a constant risk of meeting the consumer demands in terms of quality products compounded by competition for the insubstantial market from other districts for the same brand of dairy products takes the second position in the profit share. It should also be justified that milk processor has to bear fixed costs (staff salaries, rental charge, interest, depreciation) which constituted the maximum proportion of costs for the milk processor. This contradicts the findings of Ishaq, et al. (2016) who had reported that dairy processing plant has a larger share of profit in the formal milk marketing system. It should be noted that this unequal distribution of profit and added value share proves the captive governance led by milk producers and may raise concerns about the sustainability of the formal milk market in particular. At present, the procurement price of milk is determined subjectively on quantity and market forces without considering the COP. The result of this analysis is important to recognise that the COP is considered as a benchmark upon which to base their milk supply decisions in the district. It is also important to note that this information will justify the

persistent perception and claims by milk producers that milk price payment does not cover milk COP on their farm.

5.4 Stakeholders roles and information flow

Although, formal milk marketing is new in the study area, there are already many stakeholders performing various roles to promote this activity in the district. However, as opined by many stakeholders during the key informant interviews, the roles are not well defined and there are overlapping functions in mainstreaming milk value chain approach. Poor harmonisation between the stakeholders had resulted in slow progression in enough milk supply and not being able to utilise the maximum processing plant capacity.

Milk quality was also compromised because of the limited formal contracts between the stakeholders, as there are no agreed policy guidelines or specifications as to how the quality milk should be delivered and what quality standards should be met for the final dairy products. For instance, BAFRA who is one of the stakeholders in the chain opined that as a regulatory authority, they are tasked on ensuring quality standards of dairy products in the market and don't know the plans and policies of other stakeholders in the chain. Limited information and coordination amongst the stakeholders have contributed to slow progression in the existing milk value chain. This result ties well with studies of Liang, et al. (2017) who reported that stakeholders have a strong influence on the success of complex projects and is essential to understand their influence for implementation and management of joint activities.

Although milk producers, transporters and processor are the core stakeholders in this formal value chain, external supporters have an important role to play in supporting the milk value chain in order to realise the common benefit. It is only possible through greater coordination and cooperation between the stakeholders. The question now is about the changes that the milk chains need to undergo to mainstream value chain approach in the district. The District Livestock Sector who is the main supporters of the chain has to become effective chain facilitator between other supporters and to even third sector partners in order to meet the demand of fresh milk at MPU. A similar conclusion was reached by Nyokabi, et al. (2018) who mentioned that the government is the most powerful actor in the dairy sector, as it designs and implements policies in collaboration with stakeholders. The local Government of the area which has a limited role in the existing chain requires attention as they are charged with both administrative and financial role to bring development in people. Thus, it is important to highlight that one of the best models is through a co-governance system where every stakeholder accepts and plays an important role in mainstreaming milk value chain in the study area.

5.5 Opportunities towards expanding the milk value chain

This section will discuss the opportunities towards expanding the milk value chain in the district which was the main element of this research project.

5.5.1 Inclusion of Non-DFGs in scaling up milk collection

From the results section 4.9.1, key findings emerged that Non-DFGs are well aware of the benefits received from formal milk market and were interested to join the group. The results demonstrated that 90% of the total 76 Non-DFGs in three subdistricts of Barp, Shelnga-Bjemi and Talog were willing to join formal milk market and there will be a minimum of 300 litres milk collection every morning from these dairy producers. If these dairy producers enter into an agreement with the Pungdzong DFGs, this will lead to a minimum one-fold increase in milk deliveries to the MPU, from an average of 240 litres to 550

litres a day. It is almost impossible for smallholder Non-DFGs milk producers to acquire a strong position in the dairy value chain. By joining forces to supply milk in the formal milk market, farmers can enjoy a range of benefits such as transporting milk in bulk, gaining access to new technologies, financial loans and other dairy husbandry inputs. For instance, Samdrupjongkhar district in Bhutan achieved self-sufficiency in milk production with a major contribution from 16 functional DFGs (Namgyel, 2018).

Nevertheless, one of the main challenges for these milk producers to participate in formal milk market is to deliver good quality milk (Wouters and Lee, 2010) that can, however, be improved through joined stakeholder involvement in the chain activities. Kumar, et al. (2011) underlined that informal milk supply is getting replaced with commericialisation of dairying with formal milk supply chain having an inclusive structure and individual dairy producers are not excluded in joining the formal milk supply chain. As the overall goal of organising formal milk market is to link milk producers to the market and boost their income, it is an opportunity for both the parties to enter into an agreement for formal milk marketing in the district.

In result section 4.9.2, it was identified that without formal milk marketing, the major portion of the evening milk produced is being processed into butter and cheese. The study results demonstrate that half of the respondents were interested in selling evening milk. Projecting from this figure, if 50% of the total 176 members (DFGs = 108, Non-DFGs = 68) supply evening milk, the MPU will be able to collect over 390 litres of evening milk daily. Similarly, if milk processor enters into an agreement with those interested milk suppliers, this will lead to nearly two-fold increase in milk deliveries to the MPU, from an average of 550 (after linking morning milk of Non-DFGs) litres to 940 litres a day. This result confirms that this is a good choice for the milk processor to grab the opportunity to address the current gap between milk demand and supply for maximum utilisation of processing plant capacity. This is one way of linking smallholder dairy farmers to modern dairy value chains (Wouters and Lee, 2010) and will be a special feature in encouraging milk supplier to increase their milk production and supply.

It is clear that dairy producers are ready to support the milk processor in increasing milk production and collection. At present, low productivity of milking animal is a serious constraint to dairy development in the district. This is mostly due to low genetic potentials of the milk animals, and inadequate feed and fodder resources. The result also provides evidence that dairy producers wanted to increase milk productivity through crossbreeding of available low yielding nondescript cows with exotic superior breeds. This result is broadly in line with the report of Rai and Norbu (2011) who stated that AI services and estrus synchronisation programme are prioritised and adopted as an intervention strategy to improve genetic potentials of dairy cows as the jersey crossbred population is the main milk-producing animals in Bhutan. This will contribute to attaining higher milk self-sufficiency and in reducing import of milk and milk products from India.

5.5.2 Stakeholders support for expanding the milk value chain

This result cast a new light on stakeholders' support for dairy breed intensification in the milk-producing areas. The result demonstrates that the livestock sector will continue to improve genetic potentials of dairy animals through the establishment of AI centres in all eleven subdistricts, mobile AI and CHBPP activities. This is in line with Rai and Norbu (2011) who reported identifying dairy potential areas with the intensification of breed improvement activities through AI services, CHBPP and estrus synchronisation. The introduction of this breed intensification program will also lead to a reduction in

the herd size with an increased percentage of the sedentary system and higher milk productivity per milch animals.

From the result of this study, it was found that dairy farmers were constrained with inadequate feed and fodder resource due to limited landholding for fodder development. This limitation is common with most of the dairy farmers, though there are adequate fodder resources available to meet the nutrient requirement of dairy cattle in the west-central region of Bhutan (Bhujel, et al., 2018). However, this study found that the National Land Commission of Bhutan had recently formulated the land lease rules and regulation 2018 in order to facilitate various socio-economic developmental activities (National Land Commission of Bhutan, 2018). With this policy change, dairy farmers will have an opportunity to lease in the state reserved forest land to develop Tsamdrok (pasture) and enhance feed and fodder development activities in the district. The policy, financial and technical support is vital for the progression of dairy activities. The overall national, regional and district-level support for dairy development program is strong. Dairy farmers are guided by the strong policy as they play a vital role in commercialising dairy production and fulfilling the dairy commodity policy objectives, (Sonam and Martwanna, 2011). The support for establishment and preservation of fodder resources will lead to better feed, more productive cows and reduction of feed costs for the dairy farmers.

This result highlight that there are many farmers having high yielding dairy cows and interested in group formation that will support MPU in scaling up the daily milk collection. The formation of DFGs is becoming increasingly popular with the smallholder dairy farmers as they begin to realise the benefits of working in groups (Rai and Norbu, 2011). Within a decade, many DFGs have sprung across the district with the intention to deal with the collection and marketing of dairy products. Another promising finding was that the livestock sector has a plan to formally register the Pungdzong DFG with DAMC as a first dairy cooperative in the district. However, the researcher also acknowledges that there is a considerable discussion among the policymakers and implementers that the level of trust and cooperation among farmers are still low and have individualistic thinking about farming activities. This is consistent with the report of Sonam and Martwanna (2011) who cited a major weakness in mobilising and undertaking group activities due to cultural and social, technical, policy, physical, organisational, and land resources. The finding of this study should be useful in realising the importance of DFGs for expanding milk value chain in the district and inspire a higher sense of ownership among the milk suppliers.

5.6 Business Model Canvas

This study is aimed at improving the quantity and quality of milk supplied by smallholder DFGs in the district in a way to formulate best alternative business model after thoroughly considering the strengths and weaknesses of each business model. The current business model lacks enough supply of milk by the dairy farmers and most of the time, the supply is inconsistent. In chapter two, it was discussed how Polakova, et al. (2015) argued that business model can play an important role in explaining the business performance of a firm and mentioned as a strategic tool to facilitate decisions related to value creation within the business. From the analysis of the existing business model, it has come forth that elements of key activities, resources and partnership require considerations for improvement. Key activities are concerned with ownership of the processing unit over the supply chain and its decision making authority in the chain. Although milk processor seems to have a coordinating function in the chain, there is little control over quantity and quality of milk supplied by the dairy producers. At the moment it is also difficult to find the coordinated activities along the chain as was also revealed during the key informant

interviews with actors and supporters in the chain. These three elements of key activities, resources and partnership should be interdependent as already recognised by Osterwalder and Pigneur (2010). When the degree of interdependent is more, the processor will have more confidence with the chain actors and supporters and reduces the risk of not being able to operate the maximum processing plant capacity. **Table 11** explains some of the possible approach and strategies which will increase milk collection in the processing plant.

Table 11. Description of the suggested Business Model Canvas for milk processor

Key Elements	Suggested activity	Expected change	Strategies
Key Resources	Daily milk throughput	▪ Increase the number of milk suppliers (inclusion of non-DFGs members). ▪ Collection of evening milk production.	▪ Linkages and entering into an agreement with dairy producers
Key Activities	Quality milk supply	▪ Quality based milk payment system. ▪ Improving milk collection points.	▪ Capacity development of chain actors. ▪ Support construction of milk collection sheds.
Key Partnership	Stakeholder linkages	▪ Enrich understanding of value chain concept. ▪ Improve coordination and cooperation.	▪ Capacity development. ▪ Stakeholders platform.

Source: Researcher prepared (Ugyen, 2019)

5.7 Reflection

The findings in this thesis had both strengths and shortcomings related to the research approach that could have contributed to obtaining research outcome. The selection of some interview respondents might have been biased because the respondents were suggested by the head of the organisation and also had to be accessible at the time of interview. Their answers were mostly based on their experiences which could have answered their questions from the specific context of their position rather than from a broad perspective. The other limitation was on interviewing key respondents. Since all interviews had to be transcribed, the challenge was to keep the interview session short and to the point without sacrificing rapport-building conversation.

On the positive note, it was easier for the researcher to gain respondents acceptance, trust and cooperation during fieldwork as it was conducted in researcher own workplace. There were no language barriers to communicate with the respondents and it was logistically economical to travel at the study site. The researcher also had more understanding of the research subject being studied. This really helped the researcher in organising and completing the fieldwork on time.

The influence of this research approach was that most of the respondents consider the researcher as an advocate who is there to support them. Some of the respondents really could not express negative responses on the question asked for the fear of neglecting them in future as a researcher was part of the

organisation who is actively involved in the value chain development process. The researcher also realised that in the process of transcribing and classifying the relevant information, some information may have left unclassified while making data coding and comparing the content of one interview with another on a similar subject.

However, to increase the validity of the results, the researcher employed triangulation through key informant interviews, FGD and literature reviews. The researcher also prevented from losing its objectivity and biasedness by following the proposed research approaches and checklist. This really helped the researcher in understanding the existing situation and opportunities that influence their participation in expanding the milk value chain.

The lesson from this study was that the researcher must abide by the research ethics when conducting the research and ensure that research objectives are met without bias. The researcher should not rely on one research methods instead use different methods to triangulate information for the best research outcome. The conduct of one focus group discussion with representatives of Non-DFGs members would have increased the reliability and validity of the data collected.

CHAPTER VI: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

This study was an attempt to find out the possibilities of expanding the milk value chain with regard to their performance in increased milk production and supply to the processing unit. As the formal milk value chain concept is fairly new in the district, only a few producers' groups and its members actively participate at the moment. All formal milk marketing activities are established with the support from the government with the aim to achieve the economic objectives.

The milk production performance in the district implies that milk production per household is attributed to the difference in the type of dairy cattle owned, feeding and management system. The major share in the total cost of milk production was of variable cost and is important to recognise that the cost of milk production should be taken into consideration as a benchmark upon which to base their milk supply decisions.

Many milk producers prefer formal milk marketing instead of the informal distribution system due to irregular consumer demands and not being able to sell surplus milk. In terms of quality control, there is a clear knowledge gap in harvesting quality milk and supply. As such, this gap will serve as a basis to initiate an educational program in improving milk quality standards for better processor competitiveness in the market. Although, formal milk marketing is in the transition phase, there are already multi-stakeholders performing various roles to promote this activity in the district. However, without well-defined roles, there are overlapping functions in mainstreaming milk value chain approach. Poor harmonisation between the stakeholders had resulted in insufficient milk supply by the milk producers and not being able to utilise the maximum capacity of the processing plant.

Non-DFGs are well aware of the benefits received from formal milk market and were interested to join the group. Remarkably, dairy farmers are also interested in delivering evening milk to MPU. This is one way of linking smallholder dairy farmers to modern dairy value chains and will be a special feature in encouraging milk supplier to increase their milk production and supply. Dairy farmers are also guided by the strong policy support realising the role in commercialising dairy production and fulfilling the dairy commodity policy objectives.

The current business model of the milk processor is limited with enough supply of milk and is most of the time inconsistently supplied. It has come forth that these three elements of a business model; key activities, resources and partnership require considerations for improvement. The most significant findings are on the distribution of the added value and profit share, where milk producer is leading the chain with a maximum share of profit. This unequal distribution of profit and added value share proves the captive governance led by milk producers and may raise concerns about the sustainability of the formal milk market in particular.

Therefore, this study concludes that there are possibilities for expanding the milk value chain in the district. However, this can be possible by implementing the following applied recommendations made.

6.2 Applied Recommendations

From the conclusion of this study, recommendations were drawn in two forms; for immediate change and for further study.

Recommendation for immediate change

Some of the recommendations concerning immediate change are presented below with detailed implementation strategies in **Table 12**.

1) **Nurture strong linkages between chain actors and supporters.**

Since the milk supply and marketing business is multi-faceted involving multi-stakeholder in the value chain processes, stakeholders' relationship matters in the smooth transition of the business venture. The Livestock Production Officer (facilitator of change) under District Livestock Sector which is the main supporter in the chain should take a lead role in nurturing chain coordination and information flow on quality milk production, supply, processing and marketing (**see Appendix 11, p. 57**).

2) **Scale-up inclusive business by increasing the number of milk producers in the group.**

It was evident that milk producers other than members of DFGs were interested in joining the group. The processor should consider entering into an agreement with these milk suppliers for increased milk collection as the overall goal of organising formal milk market is to link milk producers to the market and increase the income of the actors involved in the milk value chain.

3) **Scale deep inclusiveness business by collecting the evening milk production.**

The milk processor should consider the possibilities of collecting evening milk from the dairy farmers since 50% of the milk producers showed their interest in supplying evening milk. This could be done by developing a simplified milk collection system which is suitable for all the parties involved in the chain.

4) **Encourage dairy producers to improve milk quality supply through quality-based milk payment systems.**

The milk processor should encourage members' participation for ensuring regular and increased milk supply through quality-based bonus payment with technical support from the district livestock sector. Milk processor can apply intervention strategies of paying bonuses to the dairy producers for delivering high-quality milk without affecting the existing milk price which is possible from increased income and profit share after chain interventions.

5) **Initiate capacity development of the staff on value chain development to mainstream value chain approach.**

The concept of the dairy value chain is gaining popularity in Bhutan particularly in the execution of the 12th FYP. It is imperative that the District Livestock Sector should initiate building the capacity of the staff on value chain development for appropriate dissemination of planned activities.

6) **Focus on developing milk collection sheds for quality milk collection and supply.**

In the absence of milk collection sheds, the quality of milk collected is being compromised during unfavourable weather conditions. Therefore, the milk processor should initiate the construction of milk collection sheds in strategic locations with the support of key partners. Public-Private Partnership (PPP) model is suitable for this program by involving Local Government of the study area and other relevant stakeholders to ensure necessary investment and effective resource management.

Table 12. Implementation strategies for expansion of milk value chain in the district

Responsible actor/supporter	Key partner/ supporters	Recommended activities	Output	Outcome	Impact
Livestock Production Officer (Mr.Pema Ugyen)	All chain actors and supporters	Conduct a workshop on mainstreaming value chain approach.	Activities logically link in the individual stakeholders' plan.	One stakeholder workshop organized at the end of December 2019. Results of the applied research findings shared.	Improved value chain governance system.
Milk Processor	Dairy producers, Milk Transporters, Extension/District Livestock Sector	Scale-up number of milk producers in the group.	Daily milk throughput increased	Increased milk collection to 550 litres from 240 litres (DFG members to 176 from 108 members) at the end of December 2019.	Achieved milk collection and processing capacity from 24% to 55%.
Milk Processor	Dairy producers, Milk Transporters, Extension/District Livestock Sector	Initiate the evening milk collection.	Daily milk throughput increased	Increased milk collection to 940 litres from 550 litres at the end of June 2020.	Achieved milk collection and processing capacity from 55% to 94%.
Livestock Production Officer (Mr.Pema Ugyen)	Dairy Producers, Milk Transporters, Extension Officers, BAFRA, RLDC	Introduce quality based milk payment system.	Milk quality improved and chain actors' income increased.	Standards for compositional and hygienic milk quality prepared and implemented at the end of June 2020.	Ensured consistent supply of good quality milk at MPU
Livestock Production Officer (Mr.Pema Ugyen)	RLDC	Train staff on Value Chain Development	The capacity of staff enhanced on mainstreaming value chain approach	1 additional value chain activities initiated in the livestock sector at the end of June 2021	Improved value chain governance
Milk Processor	Local Government, Milk Transporters, Extension/District Livestock Sector	Develop milk collection sheds in strategic locations.	Milk quality improved and chain actors' income increased.	6 milk collection sheds constructed at a strategic location at the end of June 2021.	Ensured good quality milk collection and supply.

Source: Researcher conceptualised (Ugyen, 2019)

Recommendation for further studies

These recommendations are general and may require a longer time period to implement, however, this can also contribute towards expanding milk value chain in the district.

7) **Dairy farmer groups should be encouraged to add values in the chain through joint input procurement and supply to their members.**

Almost all the dairy farmers own improved dairy cattle breeds and the milk yield of milking cow is responsive to concentrate feeding and Total Mixed Ration (TMR). The DFGs should look into the possibilities of adding value in the chain through joint procurement and supply of concentrate feed and ingredients for TMR to the members at a reasonable rate which would increase the per cow milk yield leading to the increased supply of milk by the dairy producers. The District Livestock Sector who is the main supporting agency in this value chain should conduct a feasibility study before June 2020 for the possibilities of establishing a joint input supplies facility by the end of December 2020.

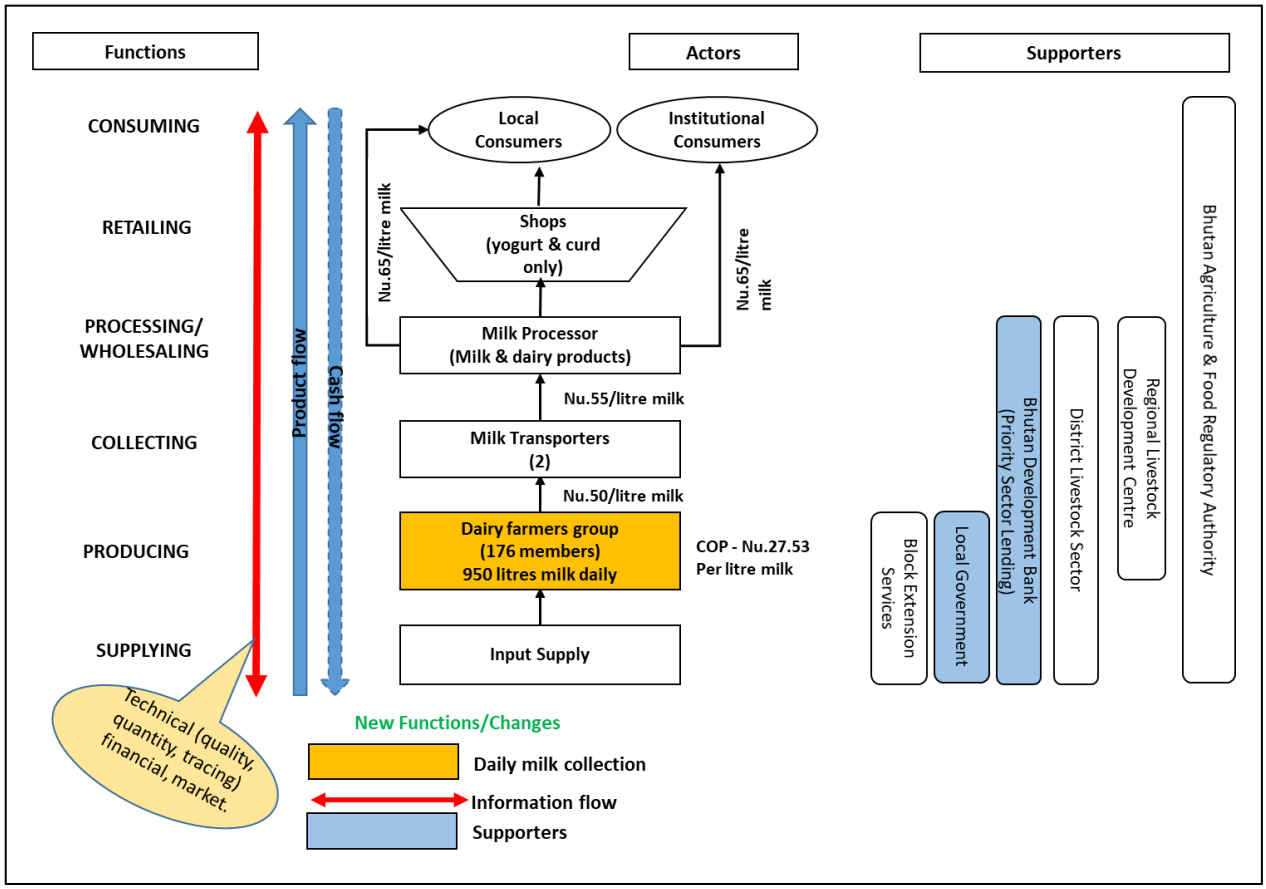
8) **Leasing state reserved land for pasture development to enhance quality fodder production.**

Dairy farmers are constrained with limited landholding for feed and fodder development. Meanwhile, the National Land Commission of Bhutan has recently endorsed the leasing of SRFL and offer provisions on leasing Tsamdrok to livestock dependent beneficiaries based on the size of the herd and the Tsamdro Management Plan. The Livestock Sector as the technical member of SRFL approving authority should initiate educational and motivational programs within December 2019 to identify the interest of existing DFGs and Non-DFGs members in leasing the SRFL for the availability of adequate quantity of fodder resources.

Recommended new value chain map

Figure 19 shows a new milk value chain after the implementation of the intervention suggested in this study which is inclusive of all the chain actors and supporters from the supply of inputs, production, collection, processing, packaging and marketing of milk and milk products.

Figure 19. Recommended future milk value chain in Punakha district



Source: Adapted from Spotlighting unpublished report (Ugyen, 2018)

Recommended Business Model Canvas

An inclusive business model with the changes in key activities, resources, partnership, cost structure and revenue streams are presented in **Table 13** (see **Appendix 12, p. 58** for detail)

Table 13. New Business Model Canvas for Milk Processor

<table>
<tr>
<td rowspan="2">8. Key Partners
• DFGs members
• Milk transporters
• Livestock sector
• BAFRA
• RLDC
Changes: Strong chain governance.</td>
<td>6. Key Activities
• Processing and packaging of milk and milk products
• Quality assessment of raw milk delivered
• Product distribution and marketing
Changes: Consistency in quantity and quality of dairy products marketed</td>
<td rowspan="2">1. Value Proposition
• Fresh milk
• Good quality
• Competitive market price
• Products - set yoghurt, curd & Ice-cream

Changes: Diversified products</td>
<td>4. Customer Relationships
• Timely delivery of products.
• Fair pricing
• Communication/ feedback
• Mutual trust/loyalty</td>
<td rowspan="2">2. Customer Segments
• Retail shops
• Hotels & Restaurants
• Schools
• Institutions</td>
</tr>
<tr>
<td>7. Key Resources
• Milk
• Skilled personnel
• MPU (rented gov. building)
• Dairy equipment (leased)
• Marketing Van
Changes: Consistency in quantity and quality of milk delivered by dairy farmers</td>
<td>3. Channels
• MPU shop
• Doorstep supplies
• Exhibition/cultural events
• Retail agents</td>
</tr>
<tr>
<td colspan="3">5.Cost Structure (Nu. 25.48 million)
• Variable costs: Nu.24.25 million
Raw milk, yoghurt cups, starter culture, bottles, electricity, processing and marketing costs.
• Fixed costs: Nu. 1.22 million
Rental charge, staff salaries, depreciation, interest, maintenance cost.</td>
<td colspan="3">9. Revenue Stream (Nu. 28.98 million)
• Fresh milk @ Nu. 6.69 million (21.19% of the revenue)
• Processed dairy products @ Nu. 24.87 million (78.81% of the revenue)

Changes: Increased annual income</td>
</tr>
<tr>
<td colspan="5">10. Social and Environment Benefit
• People: Healthier products, empowerment of small-scale dairy producer and contributing to household income generation
• Profit: Continues and increased source of income for chain actors.
• Planet: Reduced farm level processing, rearing of high yielding dairy cows)</td>
</tr>
</table>

Source: Adapted from APCM Project Management Assignment (Ugyen et.al., 2019)

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APPENDICES

Appendix 1. Survey Questionnaire

SURVEY QUESTIONNAIRE

Objective

This questionnaire is intended to find out the possibilities of **expanding the milk value chain** in Punakha district of Bhutan. Your answers will be treated completely confidential and will only be released as part of statistical analysis.

1. Demographic information

1.1 Respondent Name:…… Age: …… Village:…… Subdistricts:……

1.2 Who is the head of the household? Please tick appropriate (√) Male ☐ Female ☐

1.3 What is your highest educational level? Please tick appropriate (√)

Illiterate ☐ Primary education ☐ Secondary education ☐ Above Diploma ☐

1.4 Total farmland in acres:…… A number of household farm labour:……

2. Information on dairy farm management practices

2.1 Total cattle (head):…… Local cattle (head):…… Improved cattle (head):……

2.2 Type of dairy cattle shed. Please tick appropriate (√)

Temporary ☐ Semi-permanent ☐ Permanent ☐

2.3 How long have you been in dairy farming? Please tick appropriate (√)

1-2 years ☐ 3-4 years ☐ > 5 years ☐

2.4 Dairy cattle keeping system practiced on your farm. Please tick appropriate (√)

Stall feeding ☐ Day out, night in system ☐ **Others (specify) ……..**

2.5 Number of milking cows on the farm:……

2.6 How often are cows milked per day? Once-daily ☐ Twice daily ☐ Thrice daily ☐

2.7 Average milk production on your farm (ltr): Morning:…… Afternoon:…….. Evening:……

2.8 Do you plan to increase the amount of milk you produce? Yes ☐ No ☐

2.8.1. If yes, how do you plan to increase your milk production? ***Check all that apply.***

Purchase of cows/heifers ☐ *Growth from within the farm* ☐ *Produce more on-farm feed* ☐

Buy more feed ☐ *Depend on extension advice* ☐ ***Others (specify)****……..*

2.9 Do you provide milking cows with feed supplement? Yes ☐ No ☐

2.10 Do you have improved pasture developed on your farm? Yes ☐ No ☐

2.10.1. If Yes, the area of improved pastures you have:…… ***Acres***

2.11 Do you conserve fodder for winter feeding? Yes ☐ No ☐

2.12 Do you have enough fodder for your dairy animals for the whole year? Yes ☐ No ☐

2.12.1. If no, how do you obtain feed when experiencing a feed shortage? ***Check all that apply.***
Winter fodder cultivation ☐ *Concentrate feeding* ☐ *Fodder enrichment* ☐
Conserved fodder ☐ *Only dried crop residues/straws* ☐ *Others* ***(specify)……..***
2.13 Will you able to develop enough pasture/fodder conservation to increase milk production in future?
Yes ☐ No ☐

2.14 What is the contribution of the household members in dairy farming? **Please rank from 1–4 (1-Always, 2-Very Often, 3-Rarely & 4-Never)**

	Men	Women	Children	Hired labour
Herding cattle	☐	☐	☐	☐
Cleaning and watering	☐	☐	☐	☐
Feeding	☐	☐	☐	☐
Fodder collection	☐	☐	☐	☐
Milking	☐	☐	☐	☐
Delivery of milk in MCP	☐	☐	☐	☐
Milk processing	☐	☐	☐	☐

2.15 Do you produce biogas on your farm? Yes ☐ No ☐ No, but intend to ☐

2.16 Do you have any problem in getting access to formal credit facilities for the dairy sector? ☐ ☐
2.16.1. If yes, what are the reasons for getting limited access to credit facilities? ***Check all that apply.***
Collateral requirement ☐ Takes a long time to process a loan ☐
Limited credit information awareness ☐ Other **(specify)……..**
2.17 Are you aware of Government initiatives to support small cottage backyard farms through low-interest credit facilities (REDCL, PSL etc.) Yes ☐ No ☐
2.18 Are willing to take up such support in order to increase the animals' heads to increase milk production and supply? Yes ☐ No ☐

2.18.1. If Yes/No, Why? …….

3. Quality milk production and supply

3.1 What following activities do you perform during milk production?

	Always	**Very Often**	**Rarely**	**Never**
Do you clean milking utensils before milking?	☐	☐	☐	☐

Do you wash the udder of cows before milking?	☐	☐	☐	☐
Do you dry the udder of cows with a towel after washing?	☐	☐	☐	☐
Do you wash your hands before milking?	☐	☐	☐	☐
Do you keep milk in the cool condition right after milking?	☐	☐	☐	☐

3. For existing dairy farmers' group members

4.1 How far is the distance to collection point from your farm? <5 minutes ☐ 6-10 minutes ☐
11-20 minutes ☐ >21minutes ☐

4.2 What kind of utensils do you use to deliver the milk in the MCP?
Plastic container with lid ☐ Plastic container without lid ☐ Aluminium/steel with cover ☐
Others **(specify)_____**

4.3 Do you deliver all the morning milk produced to MPU? Yes ☐ No ☐

4.4 If No, what portion of morning milk do you supply to MPU?
>75% of milk produced ☐ 50-75% of milk produced ☐ 25-50% of milk produced ☐

4.5 Reasons for not supplying all the milk to MPU? **Check all that apply.**
Home consumption ☐ Sell to neighbours ☐ Contact with others ☐
Less milk price ☐ Others **(specify)_____**

4.6 What do you do with the evening milk produced? **Check all that apply.**

Household fresh milk consumption ☐ Butter & cheese making ☐ Sell to local customers ☐
Others **(specify)_____**

4.7 Are you interested in selling evening milk, if MPU starts collecting milk?
Yes ☐ No ☐

4.8 If yes, what is the average litre of evening milk you want to sell daily? _____**Litre(s)**

4.10 If there is an extra bonus for good quality milk supply, do you agree to supply quality milk from your farm?
Strongly agree ☐ Agree ☐ Disagree ☐ Strongly disagree ☐

4.11 Do you think there are any significant constraints in the increased milk production of your farm?
Yes ☐ No ☐

4.12 If yeas, which are the main constraints facing with your dairy farm management? **Check all that apply.**
Low yielding cattle ☐ Non-availability of good quality fodder ☐ Labour shortage ☐
Limited credit facilities ☐ Animal health issues ☐ Poor Govt. support ☐ Others **(specify)_____**

1.13 Do you think PUNGDZONG dairy group will sustain?
Very much ☐ Much ☐ To some extent ☐ Not at all ☐

4. **For new dairy farmers' group members**

5.1 Do you have a problem with selling fresh milk? Yes ☐ No ☐

5.2 If yes, are you interested to join Pungdzong DFG and supply milk to MPU? Yes ☐ No ☐

5.3 What is the average production of morning milk available for sale?_____**Litre(s)**

5.4 What do you do with the evening milk produced on your farm? **Check all that apply.**

Household fresh milk consumption ☐ Butter & cheese making ☐ Sell to local customers ☐
Others **(specify)**_____

5.5 Are you interested in selling evening milk, if MPU starts collecting milk?
Yes ☐ No ☐

5.6 If yes, what is the average production of evening milk from your farm? _____**Litre(s)**

5.7 If there is an extra bonus for good quality milk supply, do you agree to supply quality milk from your farm?
Strongly agree ☐ Agree ☐ Disagree ☐ Strongly disagree ☐

5.8 Do you think there are any significant constraints in the increased milk production of your farm?
Yes ☐ No ☐

5.9 If yes, which are the main constraints facing with your dairy farm management? **Check all that apply.**
Low yielding cattle ☐ Non-availability of good quality fodder ☐ Labour shortage ☐
Limited credit facilities ☐ Animal health issues Poor Govt. support ☐ Others **(specify)**_____

5.10 Do you think PUNGDZONG dairy group will sustain? Please tick appropriate (√)

Very much ☐ Much ☐ To some extent ☐ Not at all ☐

Appendix 2. Key informant Interviews checklist

Key Informant	Questions
Milk Transporter	**Existing situations/Constraints** ▪ Quantity and consistency of milk delivered by the farmers. ▪ Factor influencing quantity and consistency of milk delivered. ▪ Type of milk quality test you conduct in the field and farmers' perception of milk acceptance/rejection. ▪ Incidences of your milk rejection by the processor. If so, the reason for rejection. ▪ Factors influencing spoilage of raw milk at the time of milk transportation. ▪ Your views on the costs incurred in transporting milk to MPU or profit margin. **Opportunities** ▪ Possible measures to maintain milk quality during transportation. ▪ Your readiness for improving the milk value chain. ▪ Your opinion on scaling up milk collection - existing & new members, possible collection of evening milk. Your vision in 5 years for PUNGdzong dairy farmers group.
	Existing situations/Constraints ▪ Quantity and consistency of milk supplied by transporters. ▪ Factor informing quantity and consistency of milk delivered. ▪ Key problems associated with the purchase of milk. ▪ Milk quality control approaches you are following at different chain level. ▪ Incentives or other measures used to improve the milk quality from your side.

Milk Processor	▪ Opinion about the interaction/relation with other chain actors. **Opportunities** ▪ Your opinion on the inclusion of milk suppliers from other dairy farmers group. ▪ Your capability of bringing possible potential changes if you have more volume of daily milk collection. ▪ Equipment and facilities available for raw milk transportation. ▪ Business plan in the future (organisation, product diversification, marketing, etc). ▪ Your vision in 5 years for PUNGdzong dairy farmers group.
Extension Officers	**Existing situations/Constraints** ▪ Support and services of your office in the current milk value chain. ▪ Budget allocation for increased milk production and supply in the geog. ▪ Challenges to support milk value chain in the subdistrict. **Opportunities** ▪ Opinion/vision of upscaling milk value chain in the subdistrict. ▪ Opinion on the future of PUNGdzong dairy farmers group. The way forward for increased milk production and supply in the geog.
District Livestock Officer	**Existing situations/Constraints** ▪ Support and services of your office in the current milk value chain. ▪ Dairy-related policies and implementation in the district. ▪ Challenges supporting dairy chain in the district. **Opportunities** ▪ Policy, technical, subsidy and capacity development support to scale up the milk value chain in the district. ▪ Budget allocation for dairy development initiatives in the district. ▪ Opinion on the future of PUNGDZONG dairy farmers group. ▪ The way forward for increased milk production and supply in the district.
BAFRA	**Existing situations/Constraints** ▪ Support and services of your office in the current milk value chain (education/awareness, etc.). ▪ Kind of certification systems issued/required to proof credibility of the products in the market. ▪ Your opinion on the quality of milk received, processed and marketed so far from MPU. ▪ Any major issues/constraints to hygienic milk supply and processing in MPU. **Opportunities** ▪ Interventions to regulate and improve quality milk supply. ▪ Opinion on the future of PUNGDZONG dairy farmers group. The way forward for quality milk supply in the district.
RLDC	**Existing situations/Constraints** ▪ Current policies & strategies for increased milk production and supply in the region. ▪ Challenges to support milk value chain in the region. **Opportunities** ▪ Your supporting roles (budget & technical) for increased milk production and supply during the 12th FYP. Interventions to increase milk supply and marketing particularly to PUNGDZONG dairy farmers' group. The way forward for dairy development in the region.

Appendix 3. FGD checklist

- What is your general feedback about these survey findings?
- What are the factors influencing formal & informal milk market?
- Why do you think there is inconsistent milk supply based on the supply trends presented?
- How do you think of profit and value share distribution of current milk chain?
- What are the limitations or constraints of the current milk chain?
- What is your opinion on the organisation of MPU?
- What are the possibilities towards increased milk supply in MPU?

Appendix 4. Cost of producing milk per cow per day

Sl/No	Particulars	Description	Unit	Quantity	Rate (Nu)	Amount (Nu)	Reference point
1	Cost of Roughage						
	Green grass	DM intake	Kg	6	5.00	30.00	
	Hay	DM intake	Kg	1.82	2.74	4.99	KI2, KI5, FGD
2	Concentrate feed	DM intake	Kg	2	27.00	54.00	KI2, KI4 & FGD
3	Minerals or Salt	DM intake	Kg	0.03	10.00	0.30	KI5 & FGD
4	Labour	Nu.315 per day for 8 hours	Hour	2	39.37	78.74	KI6 & FGD
5	Depreciation on shed cost	Shed & silo pit construction costs Nu.25000/cow @10% year		1	6.85	6.85	KI6, KI8 & Subsidy guidelines, DoL, Bhutan (2014, p.13)
6	Shed maintenance cost	Shed maintenance cost @ 10% per year.		1	6.85	6.85	
7	Interest herd value	Cow value of Nu. 50,000 that gives 7L milk/day, 8% interest rate				10.96	KI2,KI6, KI8, FGD Priority Sector Lending Guidelines, Bhutan (2017, p.13)
	Total cost involved (Nu)					**192.68**	
	Production cost of milk/L (@7L/day)					**27.53**	

Appendix 5. Value distribution in the milk value chain

Profit and value share of milk and milk products

Chain actors	Buying price (Nu.)	Production cost (Nu.)	Selling price (Nu.)	Value-added (Nu.)	Value share (%)	Profit (Nu.)	Profit (%)
Producers		27.53	50.00	50.00	45.45	22.47	44.85
Milk transporters	50	4.08	55.00	5.00	4.55	0.92	1.84
Processor/Wholesaler	55	6.58	95.00	40.00	36.36	14.81	29.56
Retailers	95		110.00	15.00	13.64	11.90	23.75
				110.00	**100.00**	**50.10**	**100.00**

Appendix 6. Chi-square tests for the problem in selling fresh milk and interest in joining groups

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.000[a]	1	.014		
Continuity Correction[b]	2.667	1	.102		
Likelihood Ratio	4.378	1	.036		
Fisher's Exact Test				.064	.064
Linear-by-Linear Association	5.800	1	.016		
N of Valid Cases	30				

a. 3 cells (75.0%) have expected count less than 5. The minimum expected count is .50.

b. Computed only for a 2x2 table

Appendix 7. Quantity of evening milk available for supply to MPU

Particulars	**Evening milk available for supply (Litres)**			
	Average milk supply	***Minimum***	***Maximum***	***Total***
30 (50%) respondents out of 60 respondents surveyed	4.43 ± 2.25	1.00	10.00	133.00

Appendix 8. Business income statement for existing milk value chain

Business income statement for existing milk value chain (January 2018 - December 2018)

GROSS OUTPUT				**TOTAL COSTS**			
Output	**Quantity**	**Rate (Nu.)**	**Value (Nu.)**	**Costs**	**Quantity**	**Rate (Nu.)**	**Value (Nu.)**
Fresh milk (Litre)	23,958.14	65.00	1,557,279.10	Raw milk (litre)	86,619.50	55.00	4,764,072.50
Yogurt (Litre)	41,644.60	125.00	5,205,575.00	Yogurt cups (cups)	41,644.60	22.50	937,003.50
Curd (Litre)	21,016.76	65.00	1,366,089.40	starter culture - Nu.1.4/litre milk	41,644.60	1.40	58,302.44
				Processing cost - per litre milk	41,644.60	0.50	20,822.30
				Bottling for fresh milk & curd sold	45,346.90	5.00	226,734.50
				Electricity - monthly	12.00	10,000.00	120,000.00
				Marketing cost	41,644.60	0.50	20,822.30
				Interest working capital (Nu.300,000 @ 8%)			24,000.00
				TOTAL VARIABLE COSTS			**6,171,757.54**
				House rent -monthly	12.00	2,000.00	24,000.00
				3 Permanent labour - monthly	12.00	10,000.00	360,000.00
				2 family labour - monthly	12.00	10,000.00	240,000.00
				Depreciation - equipment			68,481.44
				Interest - equipment			64,492.01
				Maintenance - equipment			17,120.36
				TOTAL FIXED COSTS			**774,093.81**
TOTAL REVENUE			**8,128,943.50**	**TOTAL COSTS**			**6,945,851.35**
Per unit cost of value addition including milk price of Nu.55/litre)							**80.19**
Profit after sales/litre milk products (Nu.)							**14.81**

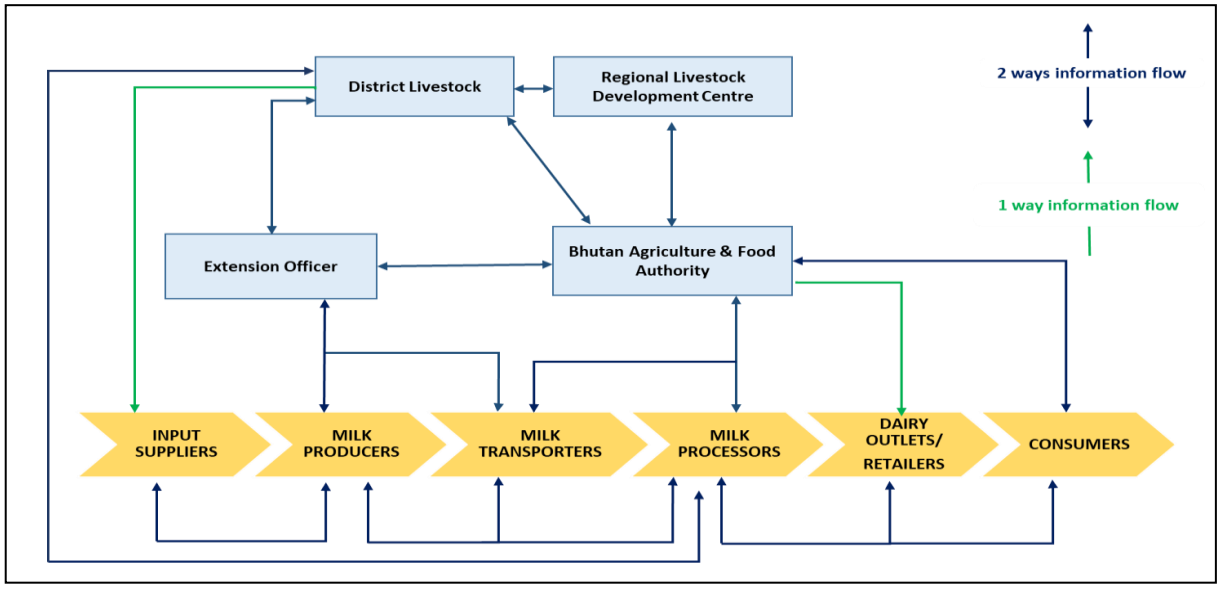
Appendix 9. Business performance of milk transporters

Business perfomance of Milk Transporter (January 2018 - December 2018)							
GROSS OUTPUT				TOTAL COSTS			
Output	**Quantity**	**Rate (Nu.)**	**Value (Nu.)**	**Costs**	**Quantity**	**Rate (Nu.)**	**Value (Nu.)**
Fresh milk (Litre)	86,619.50	55.00	4,764,072.50	Raw milk (litre)	86,619.50	50.00	4,330,975.00
				Labour (days)	365.00	315.00	114,975.00
				Transportation charge/litre milk	86,619.50	2.35	203,555.83
				Depreciation - vehicle			35,000.00
				TOTAL COSTS			**4,684,505.83**
TOTAL			**4,764,072.50**	***PROFIT (NET FARM INCOME)***			**79,566.67**
Costs of milk transportation and farmgate price							**54.08**
Profit per litre milk delivered (Nu.)							**0.92**

Appendix 10. Business performance of Retailers

Business perfomance of Retailer (January 2018 - December 2018)							
GROSS OUTPUT				TOTAL COSTS			
Output	**Quantity**	**Rate (Nu.)**	**Value (Nu.)**	**Costs**	**Quantity**	**Rate (Nu.)**	**Value (Nu.)**
Yogurt & curd (Litre)	52,152.98	110.00	5,736,827.80	Yogurt & Curd (Litre)	52,152.98	95.00	4,954,533.10
				Labour	1.00	315.00	114,975.00
				Depreciation (20% scrap value for new value of Nu.120,000 for 2 display refrigerators)			19,200.00
				Interest cost -	%	8.00	9,600.00
				Maintenance cost	%	10.00	12,000.00
				Electricity (monthly)	12.00	500.00	6,000.00
				TOTAL COSTS			**5,116,308.10**
TOTAL			**5,736,827.80**	***PROFIT (NET FARM INCOME)***			**620,519.70**
Costs of storage, marketing and purchasing cost of products per litre milk products							**98.10**
Profit after sales/litre milk products (Nu.)							**11.90**

Appendix 11. Recommended information flow in the new milk value chain



Appendix 12. Projected business income after interventions of the milk value chain

Business income statement of new value chain							
GROSS OUTPUT				TOTAL COSTS			
Output	**Quantity**	**Rate (Nu.)**	**Value (Nu.)**	**Costs**	**Quantity**	**Rate (Nu.)**	**Value (Nu.)**
Fresh milk (litre)	102,930.00	65.00	6,690,450.00	Raw milk (litre)	343,100.00	55.00	18,870,500.00
Yogurt (litre)	137,240.00	125.00	17,155,000.00	Yogurt cups (cups)	137,240.00	22.50	3,087,900.00
Curd (litre)	68,620.00	65.00	4,460,300.00	Starter culture - Nu.1.4/litre milk	137,240.00	1.40	192,136.00
Ice-cream (kg)	2,736.57	250.00	684,141.40	Sugar for ice-cream making (kg) - 12%	328.39	40.00	13,135.51
				Flavor for ice-cream making (pkt)	27.37	100.00	2,736.57
				Colour for ice-cream making (pkt)	27.37	10.00	273.66
				Stabilizers for ice-cream making (pkt)	109.46	200.00	21,892.52
				Milk powder for ice-cream making (kg)	328.39	360.00	118,219.63
				Packaging for ice-cream (cups)	2,736.57	5.00	13,682.83
				Bottling for fresh milk & curd sold	171,550.00	5.00	857,750.00
				Electricity - monthly	12.00	20,000.00	240,000.00
				Marketing cost	240,170.00	1.00	240,170.00
				Milk handling loss (2%)	6,862.00	55.00	377,410.00
				Miscealleanous (detergent, reagents)-monthly	12.00	5,000.00	60,000.00
				Interest working capital (Nu.1983778 @ 8%)			158,702.24
				TOTAL VARIABLE COSTS			**24,254,508.96**
				House rent -monthly	12.00	2,000.00	24,000.00
				5 Permanent labour - monthly	12.00	10,000.00	600,000.00
				2 family labour - monthly	12.00	10,000.00	240,000.00
				Depreciation - equipment worth Nu.1983778.00 and scrap value of 20% for 10yrs.			158,702.24
				Interest (equipment) @ 8%			158,702.24
				Maintenance (equipment) @ 2%			39,675.56
				TOTAL FIXED COSTS			**1,221,080.04**
TOTAL REVENUE			**28,989,891.40**	**TOTAL COSTS**			**25,475,589.00**
Per unit cost of value addition including milk price of Nu.55/litre)							**74.25**
Profit after sales/litre milk products (Nu.)							**52.00**