Assessment of Readiness of Adopting Quality-Based Milk Payment System (QBMPS):

a case study of Githunguri Dairy Farmers Cooperative Society in Kiambu County-Kenya.

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This Research Project submitted to Van Hall Larenstein University of Applied Sciences in Partial fulfilment of the requirements for the degree of Master of Science in Agricultural Production Chain Management Specialization Livestock Chain

This research was carried out as part of the SIA-funded project “Food Waste Reduction and Food Quality Living Lab (FORQLAB)” under the professorship of Climate Smart Dairy Value Chains (CSDVC).

By

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DECLARATION

Here by declare that this thesis is from my effort and that it has not been submitted for any word. In addition, the thesis to clarify that - Ilhan Tahlil Guled – a student of the Agricultural Production Chain Management- Livestock Specialization has successfully completed the dissertation titled: "Assessment of Readiness of Adopting Quality-Based Milk Payment System (QBMPS): A Case Study of the Githunguri Dairy Farmers Cooperative Society in Kiambu County-Kenya".

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DEDICATION

I am grateful to Allah for enabling me to write and complete this study. May peace and blessings be upon our beloved Prophet Mohamed who has guided us towards the right path. I would like to dedicate this work to my parents and husband for their love, care, and unwavering support. Pursuing a second degree has been a source of inspiration and happiness for both myself and my loved ones.

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LIST OF ABBREVIATIONS

AI	Artificial Insemination
DDA	Dutch Dairy Association
DFC	Dairy Farmer Canadian
DG	Dairy Global
GDFCS	Githunguri Dairy Farmer Cooperative Society
FAO	Food Agriculture Organization
FGD	Focus Group Discussion
FORQLAB	Food Waste Reduction and Food Quality Living Lab
KALRO	Kenya Agriculture and Livestock Research Organization
KCC	Kenya Co-operative Creameries
KDB	Kenya Dairy Board
KII	Key Informant Interview
MoALF	Ministry of Agriculture Livestock and Fisheries
KEBS	Kenya Bureau of Standard
NEMA	National Environmental Management Authorities
QBMPS	Quality-Based Milk Payment System
SCC	Somatic Cell Count
SNF	Solid Non Fat
SNV	Netherlands Development Organization
SWOT	Strength, Weakness, Opportunity, Threat.
TBC	Total Bacterial Count
TPC	Total Plate Count
VC	Value Chain
VHL	Van Hall Larenstein University of Applied Science

EXECUTIVE SUMMARY

The study was conducted in Githunguri Sub-County, Kiambu County, Kenya, focused on evaluating the readiness level of the Githunguri Dairy Cooperative Society in adopting the Quality-Based Milk Payment System (QBMPS). The primary objective was to comprehensively assess the cooperative's preparedness for implementing QBMPS. Both qualitative and quantitative data were collected for the study. A survey was conducted with 40 farmers, categorized into two clusters based on herd size (small-scale, less than 15 animals, and large-scale, more than 15 animals). Additionally, interviews were carried out with 5 cooperative staff and 5 key informants representing various stages of the dairy sector. Furthermore, a focus group discussion (FGD) was organized with 10 farmers, specifically addressing the costs and benefits associated with adopting QBMPS. To analyze the data, a statistical approach was employed, utilizing SPSS version 26 for processing qualitative data. Statistical tests such as the independent T-test were used to compare farmers from both clusters. For quantitative data analysis, the Notta app provided crucial support. The gathered data was meticulously coded, transcribed, and interpreted to derive meaningful insights. The study's findings were visually represented through diverse tools, including graphs, tables, figures, and value chain maps, to present a comprehensive and easily understandable overview of the research outcomes. The cooperative adopts several quality parameters such as organoleptic, alcohol, density, fat and protein, antibiotic residue, aflatoxin, SCC, TBC, TPC and others to ensure safe and high-quality dairy products. Enhancing milk quality, fair compensation, market competitiveness, sustainability, and member engagement were the main drivers of the cooperative to adopt QBMPS. Farmers' perception of the QBMPS was assessed in terms of their knowledge of the system and it was found that the large-scale farmers possess a higher understanding when compared to the small-scale farmers. Therefore, an exchange group is seen as essential for knowledge sharing and enhancing implementation. In addition, despite the members' reported limited awareness and knowledge of the system, both groups showed signs of interest in terms of desire to adopt QBMPS after giving an overview of the system. The study highlights the promising impact of QBMPS on milk quality, farmer income, and livelihoods, as well as the challenges in implementation costs, resistance, and concerns regarding the fairness of the system. The cooperative's ability to diversify products and enter new markets through QBMPS implementation is highlighted. The study also suggests strategies to overcome operational and financial hurdles and emphasizes the importance of targeted educational initiatives to enhance farmer understanding and participation for improved milk quality and economic benefits. The assessment of readiness levels highlights areas for enhancement, including cold chain infrastructure and sustainability practices, underlining the need for continuous improvements in various aspects for successful QBMPS integration.

Keywords: QBMPS, Dairy Value Chain, GDFCS, Githunguri Sub-County, Kenya

CHAPTER 1. INTRODUCTION

1.1 Background

1.1.1 Dairy Sector in Kenya

In Kenya, the dairy industry has a significant contribution estimated at 40% of the livestock GDP and around 4.5% of the total GDP. According to (KDB, 2015; ILRI, 2008), smallholder farmers are predominant in the dairy sector, accounting for over 80% of the countrywide dairy size with an estimated between 4.2 to 6.7 million herds and 70% of produced milk distributed through informal channels. Therefore, the dairy industry plays a significant role for farmers to increase their household income while also contributing to improving food security in the country.

Milk quality is a national issue in Kenya, threatening consumers' health. Since quality affects product yields, flavour, consistency, and shelf life, as well as profit margins and (local and export) market access, it is crucial to the sustainability of collection centres, processors and the whole industry (Caswell, 1998). Thus maintaining quality throughout the chain has always been a source of constant concern. To address this challenge, it is crucial to adopt good quality parameters through all the stages of the milk chain and minimize any potential disruptions (Pirisi et al. 2007, Franciosi et al., 2011).

1.1.2 Githunguri Dairy Famers Cooperative Society Ltd (GDFCS)

Githunguri Dairy Farmers Cooperative Society Limited was established in 1961 by the union of 30 smallholder dairy farmers to market their milk collectively and earn better prices for their milk. GDFCS is located in Githunguri Sub-County, Kiambu County and has a membership of over 20,000 smallholder dairy farmers which has a production capacity of 100,000 litres of milk per day. Githunguri Dairy Farmers Cooperative Society operates a modern milk processing plant that manufactures a variety of dairy products, such as fresh milk, yoghurt, butter, and cheese. The cooperative also provides its members with various services, for instance, providing inputs, training production of good quality forage, enhancing milk hygiene and financial management. The GDFCS is well-known for its high-quality milk production and its commitment to improving the livelihoods of its members.

1.2 Research Commissioner

The study is commissioned by VHL University under the (FORQLAB) project and the NEADAP. FORQLAB project focuses on the mitigation of post-harvest and food loss and the improvement of food quality in the avocado and dairy value chain in Kenya. The consortium of the FORQLAB project is led by six partners which are; four Dutch universities of applied sciences (VHL, HAS, Aeres and Inholland) with two Kenyan universities (Egerton and Meru), private sector players involved in both value chains, supporting organizations and other associated partners. Since the case study of this research is on Githinguri Dairy Farmers Cooperative Society (GDFCS) which is part of the FORQLAB project partners, the consortium aims to assess the readiness of Githinguri Dairy Farmers Cooperative Society to adopt a quality-based milk payment system in order to reduce the milk loss along the dairy value chain.

NEADAP (Netherlands East African Dairy Partnership) is a Dutch partner that commits to providing a forum for information exchange and promoting dairy development programs in East Africa. Within their project area, NEADAP highlights improving the quality and safety of food, especially dairy products. Therefore, they commission this study to promote the adoption of QBMPS by dairy cooperatives in Kenya in order to enhance milk quality. NEADAP possesses prior experience regards to QBMPS in East Africa, as they introduced this system to Uganda in 2018 collaborating with SNV, DDA (Dairy Development Authority), processors, collectors and farmers.

1.3 Problem Description

GDFCS empower their smallholder farmers by providing several services such as; dairy extension and AI service, outlet stores and animal health laboratories. Also, they possess a quality system which regularly tests the supplied milk and ensures milk hygiene throughout production and transportation. By adhering to this quality system, GDFCS can maintain a high standard of milk quality. However, milk is paid based on volume, which does not take into account variations in milk quality. The current payment system in the whole country encourages farmers to prioritize milk quantity over quality, even though GDFCS has penalties for those who modify the milk content. The GDFCS has an interest in shifting from a quantity-based to a quality-based payment system which will lead to standout and be more sustainable in the long run of the dairy value chain. On the other hand, the FORQLAB initiative is interested in the mitigation of food loss, and NEADAP focuses on dairy development by improving quality. However, for both GDFCS and FORQLAB, the exact readiness level of the coop to adopt QBMPS is not defined well.

1.4 Research Objectives

This research aims to study the readiness of the Githunguri Dairy Farmer Cooperative Society to adopt a quality-based milk payment system in order to establish an implementation plan to increase milk quality and mitigate milk loss within the milk value chain in Kiambu County.

1.5 Research Questions

1.5.1 Main Question

What is the level of readiness of the Githunguri Dairy Farmers Cooperative Society (GDFCS) for the adoption of a quality-based milk payment system (QBMPS)?

1.5.2 Sub-Question

1. What are the current milk quality items that GDFCS measures?

2. What are the drivers of the Githunguri coop for adopting a QBMPS?

3. What are the expectations of smallholder farmers for adopting QBMPS in terms of income?

4. What is the effect of adopting QBMPS on the farmers' income, the cooperative (cost and benefit) and the mitigation of milk loss within the milk value chain of GDFCS?

1.6 Conceptual Framework

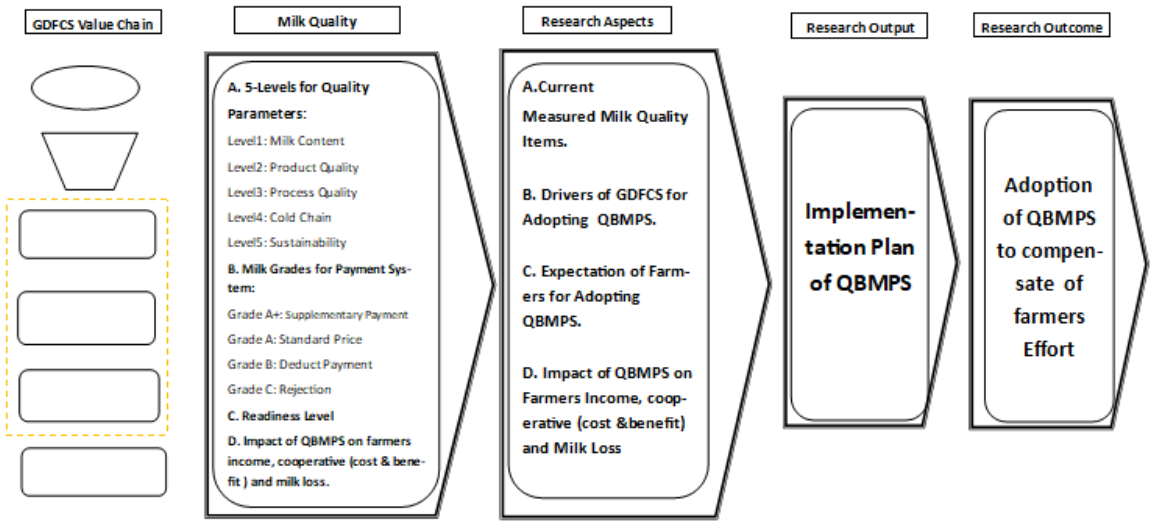

Figure 1 Conceptual Framework

Source: Adapted from Laws et al. (2013)

CHAPTER 2. LITERATURE REVIEW

There has been abundant study done in the last two decades to improve the nutritional value of milk all across the globe Previously milk quality was exclusively related to milk composition (e.g. fat, protein, lactose, and density) microbiological properties (e.g., germs, sanitation indicators, and utility factors). However, the concept is quite expanding by including other important factors like; the health of animals, the preservation of the environment the well-being of the animal (e.g. stall-feeding or grazing), and organoleptic testing (e.g. good aroma, lack of foreign fragments, milk temperature) (Mataro-Nogueras., 2015). In addition, some studies go further beyond by addressing specific parameters like; protein and fat percentage, total bacteria count (TBC), somatic cell count (SCC), and coliforms (Özkan Gülzari et al. 2020).

A QBMP system is a dynamic system and refers to a method of compensating dairy farmers for their milk production based on quality indicators. This system attempts to incentivize and reward farmers who regularly produce high-quality milk, while also ensuring fair compensation for their efforts. Depending on the policies in existence, the demands, and the aspirations of the actors, the number and combination of quality parameters in a QBMPS may differ from country to country and from stakeholder to another (Daburon et al., 2019). Dairy Dutch Association (DDA) indicated that assuring the safety, quality and content of raw milk has two main pillars, setting a quality-based payment system for raw milk to the farmers and establishing a combined monitoring program for impurities and remains in raw milk.

During the last decades, there has been increasing awareness regarding milk quality, and all the above-mentioned quality indicators are used to assure the safety and quality of milk and milk products. However, in the literature, it is hard to find a developing country that successfully adopted these indicators as payment parameters due to several factors like; prioritising quantity to meet market demand, the dominance of small-scale farmers in the production, absence of consumer awareness about quality as result majority of the customers are unwilling to pay more for goods, the high cost of the resources like laboratory equipment and limited capacity to impose the implementation of quality standards in the dairy sector.

The QBMPS employs different quality parameters in different nations. In South Africa and Zimbabwe, microbial parameters such as (TBC, SCC and mastitis) were considered crucial indicators (Özkan Gülzari et al., 2020). In Ethiopia, payment was based on bacterial and milk fat levels (Steen & Maijers., 2014). TPC, antibiotic residues, the point of freezing, and total solids were considered in Kenya (Ndambi et al., 2018), while butter-fat and SNF were used in Uganda (SNV., 2017).

According to Katarama (2022), GDFCS at MCC conducts tests such as a lactometer test for density or adulteration, an alcohol test for mastitis, and an Organoleptic test using sense organs. Aflatoxin level, antibiotic residue in milk, and the somatic cell count are all tested at processing plants. Other quality indicators were checked but received little attention at collection centers, and milk was not rejected based on protein, fat, or aflatoxin levels.

Dairy farmer members are paid based on the monthly guaranteed price. The milk money is determined by the amount of protein, fat, and lactose in the milk supplied by the member farmer. The gap between the guaranteed price and milk money is caused by the offset of fixed expenses and supplements or

charges. Regular farms' fixed costs in 2023 are 0.20 euros for every 100 kilograms of farm milk delivered (FrieslandCampina., 2023).

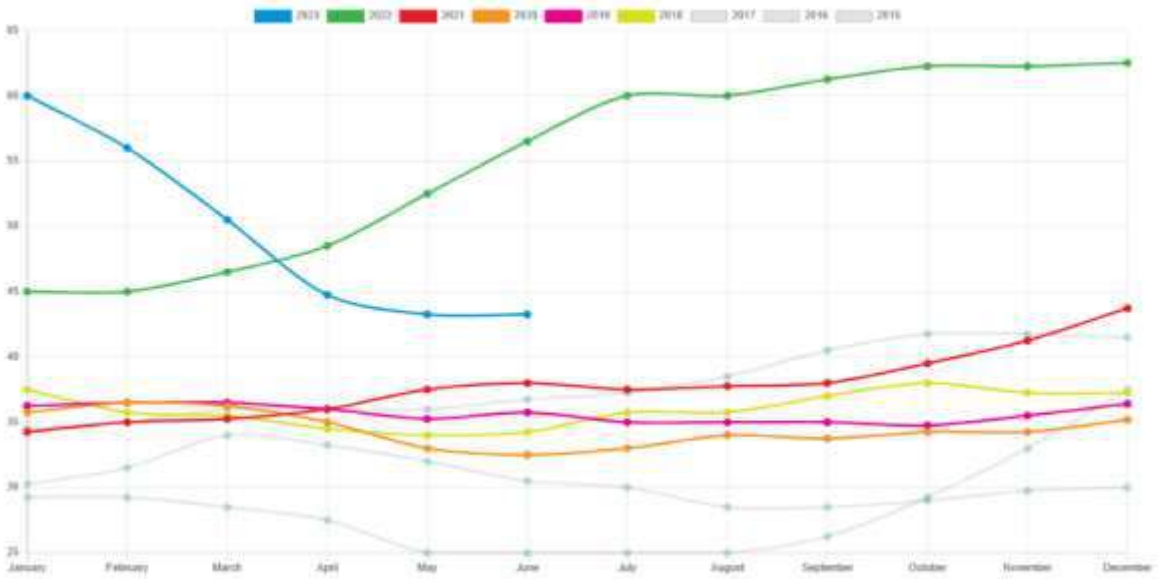

Figure 2 Monthly Guaranteed Price by Friesland Campina

Source: Friesland Campina (FC 2023)

Taking into consideration all the above-mentioned quality parameters, this study will combine some parameters and categorize them into four different levels (1-4) of quality measurements which can be used in the payment system to assess the adoption of readiness.

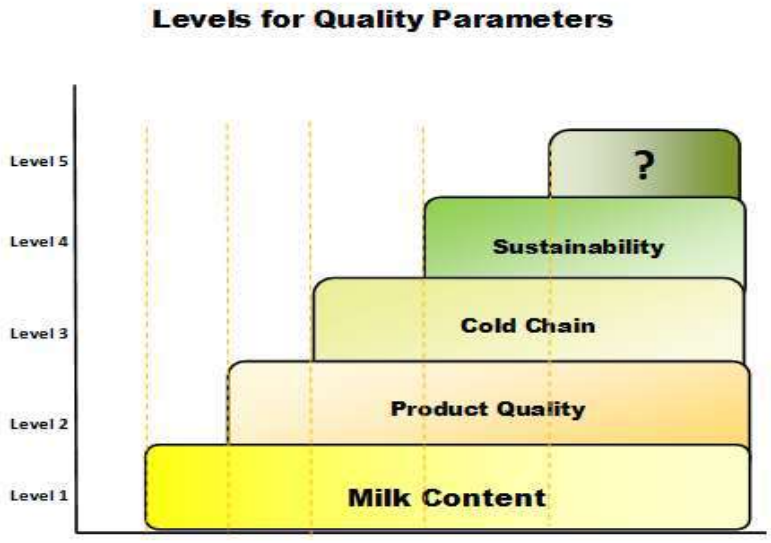

Figure 3 Levels of Quality Parameters

Source: Adopted from Friesland Campina Foqus Planet (2012)

2.1 Current Measured Milk Quality Parameters

2.1.1 Level One: Milk Content (Protein and Fat)

For three decades, dairy industry leaders (the Netherlands and Denmark), have paid to the milk suppliers for protein and fat content. In countries such as Costa Rica and Spain, payment is made based on dry extract rather than protein content. In Friesland Campina, previously used to pay fat, protein and lactose in the ratio of 10-5-1. However, a new proposal indicated to exclude lactose because of the inability to manage by the entrepreneurs and decided to consider only fat and protein with a 6-4 ratio (Stokkermans., 2022).

In Canada, fat, protein and somatic cell counts are the most important quality indicators while in the payment system, protein is given a higher value (Bailone., 2019). In Kenya, Kabui (2012) stated that the average fat and protein composition in the milk was 3.8%, and 3.1% respectively.

2.1.2 Level Two: Milk Quality (SCC, TBC, Mastitis, Antibiotic residue, Aflatoxin and Adulteration)

Somatic Cell Count:

Somatic Cell Count (SCC) is an important milk quality indicator because it reflects the health of the mammary gland and the danger of non-physiological alterations in milk composition. A healthy udder quarter has an SCC of 100,000 cells/ml and is pathogen free (Dohoo and Meek 1982; Hamann 2005). The EU milk quality standard (SCC less than 400,000 cells/ml) is often regarded as the international export standard. The national BMSCC (bulk milk somatic cell count) in Norway is 115,000 cells/ml; in Ireland, this value was roughly 250,000 cells/ml in 2004, and the national penalty limitations in the United States is 750,000 (van Schaik et al. 2002).

In Denmark, payment is based on hygiene quality in four categories, with the second (less than 100,000 pathogens) determining the fundamental price. Producers receive a 2.5% value premium for top milk quality (less than 30,000 germs), whereas lower quality milk receives a reduction (Bailone., 2019). The highest somatic cell count (SCC) allowed for Canadian dairy farmers is 400,000 cells/ml of milk. The Canadian average is less than half that amount because of the awareness of farmers on cows' health (Dairy Farmer Canadian 2021).

Presence of high level of SCC in the milk has a negative impact on cheese production due to lower curd hardness, decreased milk yield, higher fat and casein loss in whey, and poor sensory quality. High SCC milk also has an impact on the quality and shelf life of pasteurised liquid milk. Milk loss from high SCC ranges from 0.3 to 1.8 l/cow/day, depending on lactation stage and SCC level (More., 2009).

Antibiotic residue:

Antibiotic-containing milk has to be rejected, and suppliers of antibiotic milk should face financial penalties. Dairy Farmer of Canadian (2021) stated that several antibiotic residue checks and balances are in place in the Canadian farms and processing plant. The test is carried out before the milk truck is admitted to the plant. This indicates zero antibiotic detection in the milk processed in the plant. The

GDFCS specification of antibiotic residue is not more than 10ppb, where KEBS standard is should be negative (Katarama., 2022).

A paper carried out to investigate quality control of raw milk in the smallholder collection and bulking enterprises in Nakuru and Nyandarua. The study found greater levels of antibiotic residues, implying that no withdrawal time was observed. To address this, they recommended to include antibiotic residue test in a quality-based payment system and provide farmers with extensive training (Ndungu et al., 2016).

Aflatoxin:

The level of Aflatoxin M1 authorized in milk and dairy products is highly restricted in the developed nations, due to its significant hepato-carcinogenic potential. The regulatory limit for AFM1 in milk and dairy products in EU countries is 50 ppt and 500 ppt in the US (Bellio et al., 2016).

A study in Kenya evaluated milk consumers' behavior to aflatoxin and discovered that consumers are aware about aflatoxin risk at the same time willing to pay premium price for certified aflatoxin-free milk (Mtimet et al., 2015).

Adulteration:

Milk adulteration is becoming a severe problem over the world. Around 68% of milk distributed to customers fail to meet guidelines. The usage of contaminated low-quality milk might have consequence on human health. As a result, it is critical to have an effective and dependable quality control system in place that will frequently monitor and ensure a quality supply of milk to consumers (Tolcha., 2023).

A study by Ndungu et al. (2016), revealed that adulteration of milk with water was common in Nakuru and Nyandarua, which could be attributed to farmers being paid based on quantity supplied. Milk policies should be developed, and heavy penalties should be imposed on farmers who are adultery the milk, as opposed to the current situation in which no action is done.

2.1.3 Level Three: Cold Chain (cooling tank, distance, frequency)

Cold Chain Management (CCM) is defined by Shabani, Saen, and Torabipour (2012) as a system for handling activities involving perishable goods such as medicine, blood, dairy, meat, food, vegetables, mushrooms, flowers, and fruit products that must be distributed at certain time and preserved in a specific atmosphere circumstances. Teresiah et al. (2016) described how using low-quality water to clean milk handling equipment might contaminate the milk and emphasized the importance of maintaining an ambient temperature throughout the cold chain to ensure quality and shelf life.

In advanced countries, such as Canada, the installation of a cooling tank on the farm is not an issue because milk is collected from the farm every one to two days and is still as fresh as it was milked from the cow. Before being put into the truck, it is evaluated and tested for quality by a qualified expert (DFC., 2021). Milk is picked up and transported in customized tankers by professional drivers in the Netherlands; at pickup, the drivers are responsible for doing the initial quality test of the milk. The government is responsible for driver education and expertise, and it collaborates closely with the Dutch dairy sector to organize and regulate milk trucks (DDA- N.Y).

Using aluminum milk cans and reducing the time between production and the reception of the chilling plant by delivering milk within two hours increased milk quality (EAAD, 2013, SNV., 2012). However, in countries where smallholder farmers are predominant like Kenya this has big effect on the milk quality.

The delivery time of milk is an important factor in value chain activities: if the delivery time is lowered, milk quality improves. Johnson et al. (2015) reported that in Mozambique, quality is degraded between milking and delivery to remote MCCs, and if quality is maintained, even though higher quality milk is not rewarded, the MCC is unlikely to reject it.

Smallholder farmers in Zimbabwe, for example, who deliver their milk to neighbouring MCCs where milk is combined earn an incentive on the quality of the milk (Paraffin et al., 2018). Market rejection results from insufficient handling and the time required to reach markets (far distances and bad roads). Rejections are higher during the wet season, when production is high and roads are difficult (Teresiah et al. 2016). The most significant problem in the entire raw milk collecting chain is proper methods to sustain cold collection due to the high investment costs necessary. This has a disproportionate influence on both the informal and formal sectors (Orregrd., 2013).

The GDFCS has 86 milk collection centers; 12 of which are equipped with coolers and collect milk in bulk. To shorten the distance between farms and collecting centers, the cooperative established approximately 163 mobile collection points in various locations (Katarama., 2022).

2.1.4 Level Four: Sustainability

Food sustainability and safety are becoming increasingly important for many internationally traded commodities, such as coffee, and milk payments may be reliant on farmers adhering to sustainable techniques that have yet to be distributed to other regions worldwide.

According to Dairy Global (2021), the Dutch dairy industry places a great emphasis on sustainability as same as animal health and biodiversity. The sustainability is driven in part by programs such as Duurzame Zuivelketen (in Dutch), which focuses on climate-responsible production, animal health and welfare, outdoor grazing preservation, biodiversity, and the environment, but it is also driven by initiatives such as PlanetProof. PlanetProof enforces dairy farmers to follow guidelines on quality, farm management and pasturing; cows must graze for a minimum of 120 hours, 6 hours per day, with a limit of 10 cows per hectare of grassland. In addition, safeguarding biodiversity, the climate (by imposing strict requirements on maximum GHG emissions and the mandatory use of locally-produced animal feed), animal welfare and health (plus monitoring of mature cows and young stock), as well as complete freedom of movement for the animal by providing cow brushes to enhance cow comfort and skin care.

Friesland Campina is currently working with their member dairy farmers, partners, and clients to produce climate-neutral dairy, as well as through specific programs such as our Foqus planet initiative. To achieve this, we intend to reduce our emissions by 63% between 2015 and 2030 for scopes 1 and 2 'production and transport,' 33% for scope 3'member milk,' and 43% for the rest of scope 3, such as packaging.

A research in the Netherlands compares the efficiency of conventional and organic dairy production in terms of both the economy and the environment (Wairimu et al. 2021). The authors examine costs

associated with milk production, revenue, and greenhouse gas emissions. According to their findings, raising milk pricing through organic dairy farming can offset higher production costs. In terms of fewer greenhouse gas emissions, organic farming performs better for the environment overall.

A study conducted in Spain assessed willingness of consumers to pay premium price for certified organic milk. The results shown that consumers were willing to pay higher price for milk that has been produced organically (Akaichi et al., 2012). According to a research conducted on 382 dairy farms in Central Kenya, encompassing Kiambu county, the average Carbon Footprint (CF) ranges from 2.2 to 3.1 CO2-eq FPCM, which was in line with the FAO 2010 result of 1.3 to 2.0 globally (Wilkes et al., 2020).

2.2 Effect of payment on enhancing quality

Improper adjustment of incentives toward quality parameters in the dairy value chains may limit quality and thus act as a barrier to smallholder participation in upgrading value chain. For instance; a cooperative in Indonesia used to pay based on the average quality delivered by its farmer members before introducing individual quality incentive. The adoption of the intervention started in simple steps by improving milk hygiene, upgrading part of the cooperative's milk collecting points (MCPs), training coop members. Following the upgrade, prices were based on the quality given by the individual farmer using the same price function as previously (with the exception of some additional bonuses for good hygienic quality of milk) (Treurniet., 2021).

A study investigated the role of individual quality incentives provided by the privet sector promote milk quality in Indonesia. They found out that individual quality incentives increase the quality content of milk quickly after introducing it to the smallholder farmers. Individual quality incentives together with physical inputs and training also improved the hygienic quality of milk (Treurniet., 2021).

2.3 Current Quality Parameters Measured by GDCFS and its Standard

Table 1 Current Quality Parameters

	GDFCS Standard Amount	Kenyan Standard	The Netherland Standard/goal
Chemical Content:			
♦ Fat	3.5%	3.46%	4.57
♦ Protein	3.2%	3.61%	3.62
♦ SNF	Min 8.5%	9.18	
♦ PH	6.6-6.8	0.13 - 0.14%	6.6-.68
♦ Freezing point	0.55-0.525 C^0	-0.597	-0.520
♦ Alcohol test	Negative	Negative	Negative
Adulteration			
♦ Density 200C	1.028 - 1.034g/ml	1.031g/ml	
	0%		
♦ Added Water	-	-	Negative
♦ Preservation	-	-	Negative
Product Quality			
♦ SCC	Mx 300,000	≤300,000	200,000/ml
♦ TBC	max 2,000,000cfu/ml.	<200,000 Grade A 1-200,000 Grade B	100,000 cfu/ml
♦ Aflatoxin	Less or equal to 0.5ppb.	≤200,000 Grade C ≤0.5ppb	
♦ Mastitis	Negative	Negative	Negative
♦ Antibiotic residue	Not more than 10ppb	Negative	Negative
Sustainability			
♦ **Outdoor grazing**	-	-	85% of farmers implementing current
♦ **GHG Emissions**	-	-	20% reduce current
♦ **Biodiversity**	-	-	30% protect biodiversity
Farmers Awareness			Aware
Consumers' quality awareness			Aware

Source: KATARAMA (2022), KDB AND Brodziak (2021)

2.4 Milk Grading and Pricing

Milk grading and pricing systems are crucial to the dairy sector, ensuring quality standards and farmers receive fair compensation. For classification and quality control purposes, the dairy sector uses a variety of milk grades. According to Oliver et al. (2005), Skeie et al. (2019), and Müller et al. (2022), these grades are established based on a number of variables including milking hygiene, milk composition, and microbiological quality. Depending on the specific method employed, different milk grades can be categorized, but generally speaking, there are low, medium, and high grades (Habsari et al., 2022).

Table 2 Raw Milk Grades

GRADE	PRICE BAND
GRADE I or **A** $^{+}$	Premium Supplementary Payment
GRADE I or A	Standard Price (Guaranteed Price)
GRADE II or B	Deducted Payment
GRADE III or C	Rejection

- Grade A^{+} milk quality meets the required standards with extra parameters like extra protein or fat content; therefore, payment will be the standard plus an extra bonus for those who exceeded the requirements.
- Grade A milk meet the required quality standards so, the payment is guaranteed price, with no extra bonus or deduction.
- Grade B milk is slightly lower than the basic standards, a deduction will be applied.
- Grade C milk is under the standards and may contain higher bacteria and somatic cell count or adultered in any way which is not suitable for human consumption. This type of milk is automatically rejected, and the producer will face a penalty.

2.5 Readiness for Adoption of QBMPS

According to Dairy Dutch Association (DDA), milk must meet certain requirements in terms of fat percentage, lactose content, protein content, cell count, bacterial count, contamination levels, freezing point, butyric acid bacterium traces, fat acidity, antibiotics, and chloroform concentration. The findings of the tests also support in determining payment to the milk producers. However, in developing countries like Kenya, meeting all these standard at once seems unfeasible at current situation. Therefore, cooperative and processors need to set priority regarding to the essential quality parameters starting from farm level and discuss with their milk suppliers.

CHAPTER 3. RESEARCH METHODOLOGY

3.1 Study Area

Kiambu county is located in Central Kenya and comprises 12 constituencies. Githunguri is one of the agricultural sub counties in Kiambu county and hosts Fresha, (one of largest milk processing plant in East Africa), which is run by the Githunguri Dairy Farmers Cooperative Society. Upper highland, Lower highland, Upper midland, and Lower midland are the four zones that make up the Kiambu county.

Githunguri sub county has a population of 165,232 and is located in the Lower highland zone at an elevation of 15,000-18,00 meters above sea level. The yearly temperature in the sub-county is 20.4oC (68.72oF), which is -2.1% lower than the national average. The sub-county has fertile red volcanic soils that support a variety of crops and dairy production. Zero grazing is a key livestock production technology in which feed is cut and delivered to cattle in their housing units.

Figure 4 Map of Kiambu County

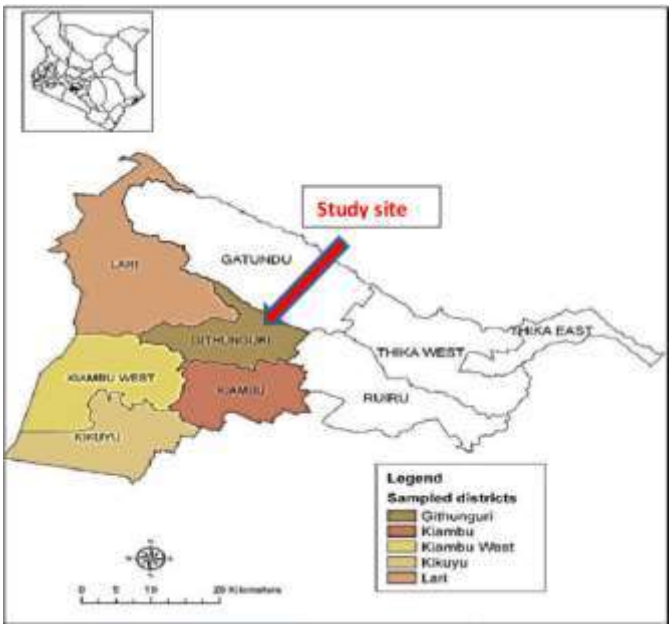

Figure 5 Githunguri Map

3.2 Research Design

The study used both qualitative and quantitative approaches. Qualitative research was utilized to understand the topic in-depth. To triangulate the study, data was collected through semi-structured interviews with key informants and focus group discussions involving coop staff, extension officers, and farmers.

Table 3 Research Methods and Tools based on Research Sub-questions.

Sub-research Question	Methods	Tool	Respondents	Data Analysis
Q1.1 **Current milk quality items**	Case study	Interview (Semi-Structured Question)	Coop Mangers Quality control officer	Qualitative (Transcribing & Coding)
Q1.2 **The drivers for adopting a QBMPS**	Case study	Interview (Semi-Structured Question) Ranking form	Coop Managers & staff	Qualitative (Transcribing & Coding) Excel
Q1.3 **The expectations of smallholder farmers for adopting QBMPS in terms of income?**	Case study	Survey (Structured Question)	Farmers (40)	Quantitative (SPSS)
Q1.4 **The effect of adopting QBMPS on the farmers income, cooperative (cost & benefit) and mitigation of milk loss.**	Focus Group Discussion. Case study	Ranking Interview (Semi-Structured Question)	**Chain Actor:** GDFCS **Chain Supporters:** (NEADAP, KALRO, KDB, Policy and market specialist and livestock officer-Githunguri headquarter)	Excel Qualitative (Coding)

3.3 Research Framework

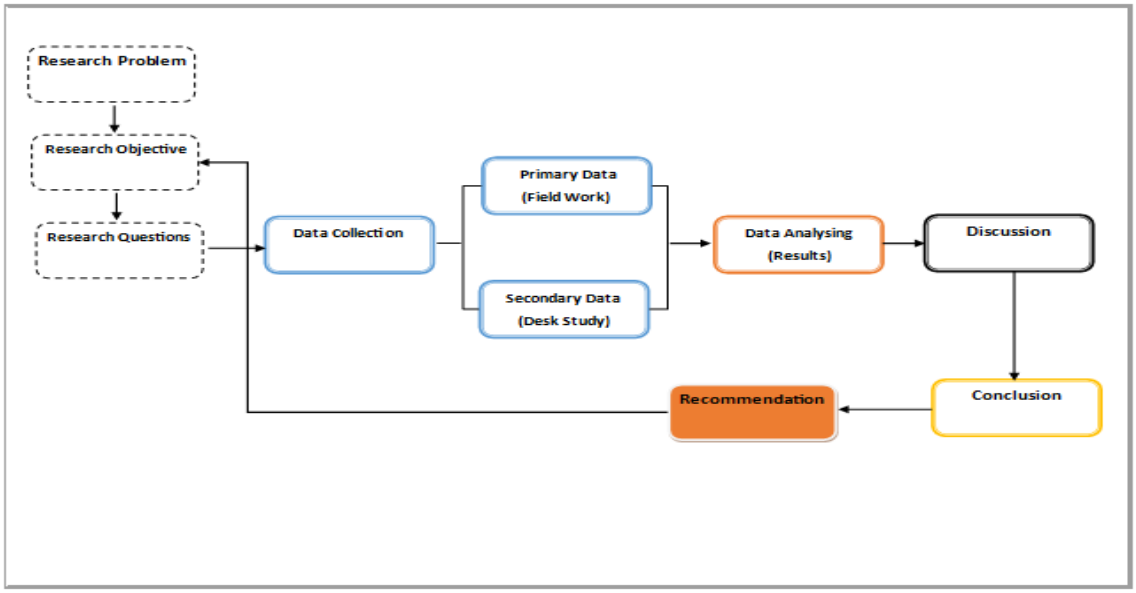

Figure 6 Research Framework

Source: Authors' Design

3.4 Data Collection

To achieve the objective of this study, various methods were used, including desk research, surveys, interviews, and focus group discussions. Each of these methods had unique advantages in acquiring information, and combining them provided a fully comprehensive understanding of the subject.

3.4.1 Desk research

Desk research is conducted to understand the concept and identify the knowledge gap. Desk research used to collect existing secondary data from academic search engines (Google Scholar, Greeni and Research-Gate), government official reports, and publications on previous and current investigations. Boolean operators "AND" and "OR" with combination of key words was used to find significant literature.

3.4.2 Survey

A survey was conducted in this study, utilizing a structured questionnaire to gather both quantitative and qualitative data from 40 farmers categorized into two distinct clusters. The questionnaire was designed with a combination of open and closed-ended questions, enabling the collection of statistical data and facilitating a comparison of differing expectations among the various groups. The survey was carried out by visiting the farmers at their farms or at the MCC, where they filled out the questionnaires.

Sampling Method

The research used probability-simple random samples, particularly cluster samples, for sample selection. In this approach, 40 smallholder farmers (Members of Githunguri Cooperative) were grouped into two distinct clusters based on the number of cows they owned: Large size (>15 cows) and Small (<15 cows). Each cluster contained 20 farmers with the same farm size. This choice was made because the study aimed to explore the perceptions and expectations of farmers regarding the adoption of QBMPS. It was anticipated that the farmers' expectations would be influenced by their farm size, with larger farms showing a greater interest in adopting quality-based practices

3.4.3 Interview

The study organized interviews with 10 diverse key informants in the dairy value chain. The participants were included chain supporters such as KALRO, livestock officer from government of Kiambu County, NEADAP, policy and market specialist, and KDB as well as GDFCSs' staff members for instance; quality managers, manager deputy of processing plant, quality inspector, grader and extension officers. During the interview, two ranking was provided to the cooperative staff to assess the drivers of cooperative to adopt the quality system and to rank the readiness level of cooperative to implement the system. The ranking form encompassed 5 levels for quality parameters adopted from Friesland Campina as illustrated in figure3. All the participants were selected based on their professional expertise and background related to the focus of the study, which was the quality-based payment system. Before the interviews, the

participants were asked to provide their consent to participate, and this consent was obtained either orally or in written form.

Table 4 List of Key Informants Interviewed

	Title of the Participants	**No. of KII**
Cooperative staff	Deputy of the Process manager	1
	Quality Officer	1
	Milk Inspector	1
	Milk Grader	1
	Extension Officer	1
Chain Supporters	KDB	1
	Githunguri Head Quarter- Livestock Officer	1
	Policy and Market specialist	1
	KALRO	1
	NEADAP	1
Total		10

3.4.4 Focus Group Discussion

A Focus Group Discussion was organized as a fundamental component of the study. The FGD was considerately designed to encompass the perspectives of a diverse group of 10 farmers, with a balanced representation of 5 from the large-scale farming sector and 5 from the small-scale sector, ensuring equal gender representation. To facilitate a productive discussion, the participants were divided into two distinct groups mixing both large and small-scale farmers. Each group was equipped with a flipchart to document their respective perspectives. The focus was to encourage a fruitful exchange of ideas and viewpoints within each group. Both groups were enquired to discuss their point of view about the cost and benefit of adopting QBMPS by comparing the existing system which is based on volume. After the debate, each group presented their points and discussed them with the whole group. At the end of the session, a ranking form was provided to the farmers in order to assess the effect of adopting QBMPS on farmers' income and to evaluate the cost and benefit of implementing such a system. The results from FGD were used to validate the data collected from the interviews and surveys. It also guided the data by providing valuable qualitative insights from both Githunguri cooperative and farmers

3.6 Data Analysing

The qualitative data collected from the questionnaire which filled by 40 farmers under the two clusters (small and large-scale) were analyzed using SPSS to compare the differences between the farmers' clusters. The statistical test, independent sample T-test were used to determine whether there is statistical difference associated between the two groups. In order to determine the frequency of a variable, descriptive statistics were used. The average milk yield per cow per day at the height of production, among other variables, were also determined using it, as well as their lowest and maximum values.

Simultaneously, the data from the interviews with key informants and focus group discussions (ranking form) were transcribed and coded to categorize the information. Excel was used to develop graph descriptions. SWOT analysis was then conducted using the text to determine the prospects for locating sustainable intervention sites. The loss and leverage points that were crucial in creating the interventions were also shown on the value chain map.

3.7 Ethical Issue

According to Laws et al. (2013), ethical issues are a major part of the research process and include crucial elements including obtaining participants' agreement and maintaining data confidentiality. All participants' informed consent was diligently sought out and gained by the researcher, who made sure they were aware of the goals, methods, and important information pertaining to their participation. Every participant received thorough information, giving them the freedom to decide whether or not to participate. Participants also kept the right to withdraw from the study if they felt it was necessary, supporting their independence and ability to stop participating at any time.

3.8 Study Limitation

The research was conducted in Kenya, which is not my home country. Therefore, being an outsider presented both opportunities and challenges. One of the challenges was identifying and contacting relevant stakeholders such as extension or government officers. Additionally, during the survey phase, challenges arose in contacting some farmers due to language barriers since I was unable to speak their first language, making translation a challenge. Moreover, some farmers hesitated to participate in the study regarding the sensitivity of the topic, which was the quality of their precious product, especially among those who performed less in terms of quality parameters.

CHAPTER 4: RESULTS

This chapter presents the results of the data collected from field by questioner, key informant interviews and focus group discussion. The analysis is organized according to the research sub-questions. The results were presented in tables, figures and descriptions.

Section A Result of the Survey:

The survey contains a questionnaire structured for the farmers and it has been categorized into two distinct sub-groups based on the size of their farming operation (small-scale<15 and large-scale>15 Animals). The questionnaire used in this study included a wide range of questions. These inquiries aim to gather essential information regarding the perception of farmers, evaluate their level of familiarity with the QBMPS, and assess their readiness to implement and put the QBMP system into practice.

4.1 Demographics:

During the survey, a total of 40 farmers were visited, consisting of 20 small-scale (<15) and 20 large-scale (>15). In terms of gender distribution, 60% of the respondents were male while 40% were female. The majority of survey participants (90%) were under the age of 30 or above, with only 10% being under the age of 30 (youth category). This shows the less involvement of youth in the dairy business in Githunguri and highlights the need to come up with initiatives to incentivize the youth and increase their participation in the sector. Regarding the educational background of the respondents, 5% of the respondents attended primary school, 52% possessed a high school certificate, 10% held a diploma and 33% had achieved university level.

Table 5 General Characteristics of the Survey Respondents

Parameter	Percentage N= 40
Gender:	
Female	40 %
Male	60 %
Age	
< 30	10%
>30	90%
Education Level	
Primary school	5%
Secondary school	52%
Diploma/Certificate	10%
University	33%
Herd Size	
Small-scale > 15	50%
Large-scale < 15	50%

Production parameters:

According to the survey findings, the average milk production in large-scale farmers (>15) was found above 20L/day/cow and the average of small-scale farmers was around 13L/day/cow as shown in Table 6. This remarkable contrast demonstrates the significant production difference present in the dairy farming industry in Githunguri. Moreover, this production gap has an effect on small-scale farmers' income and their livelihood status. Large-scale businesses tend to be able to produce more milk per cow, enabling them to make more revenue. This is particularly significant in the context of dairy farming, where production efficiency may influence profit margins.

The breed type among farmers in the Githunguri dairy cooperative did not show significant differences (P>0.86). both sub-groups highlighted using exotic breeds (Friesian Holstein) as the main source of milk production. For the AI services, farmers recorded that they chose the semen according to the productivity of the Bull. Survey respondents were asked if they cultivate, purchase or engage in both (grow & purchase) to obtain forage for feeding the cows. The majority from both sub-groups stated that they grow their forage and mainly depend on Napier grass as the main source of forage.

Regarding the delivery centres, farmers were asked if they deliver to the cooling or collection center. There is no significant difference between the groups (P-value= 1.00). However, in terms of quality, those who deliver to the cooling centre has more chances to conduct further test due to the availability of quiet tests at the cooling center. In contrast, collection centres only have density tests, alcohol tests and organoleptic tests available. Concerning the distance from the farm to the collection/cooling centre, both the huge number among the clusters mentioned less than 1 km.

Table 6 Production Parameters

	Small-Scale N= 20 Number. Respondents	Large-Scale N=20 Number. Respondents	P-Value (0.05)
Milk production	10L/cow/day	22L/cow/day	0.001
Breed Type			0.861
Exotic Breed	17	18	
Cross Breed	2	0	
Mixed	1	2	
Semen Selection terms	1.5 ±	1.36 ±	0.807
Production	11	15	
Cost	9	2	
Other	0	3	
Forage (Grow/Purchase)	1.33 ±	1.68 ±	0.195
Grow	16		
Purchase	1		
Both	3		
Deliver to Collection /Cooling Center	1.11 ±	1.18 ±	1.00

Collection Center	17	16	
Cooling Center	3	4	
Distance to delivery center	1.05 ±	1.09 ±	0.560
> 1 KM	19	18	
< 1 KM	1	2	
Knowledge of Milk Tests			
Yes	11	18	0.013
No	9	2	

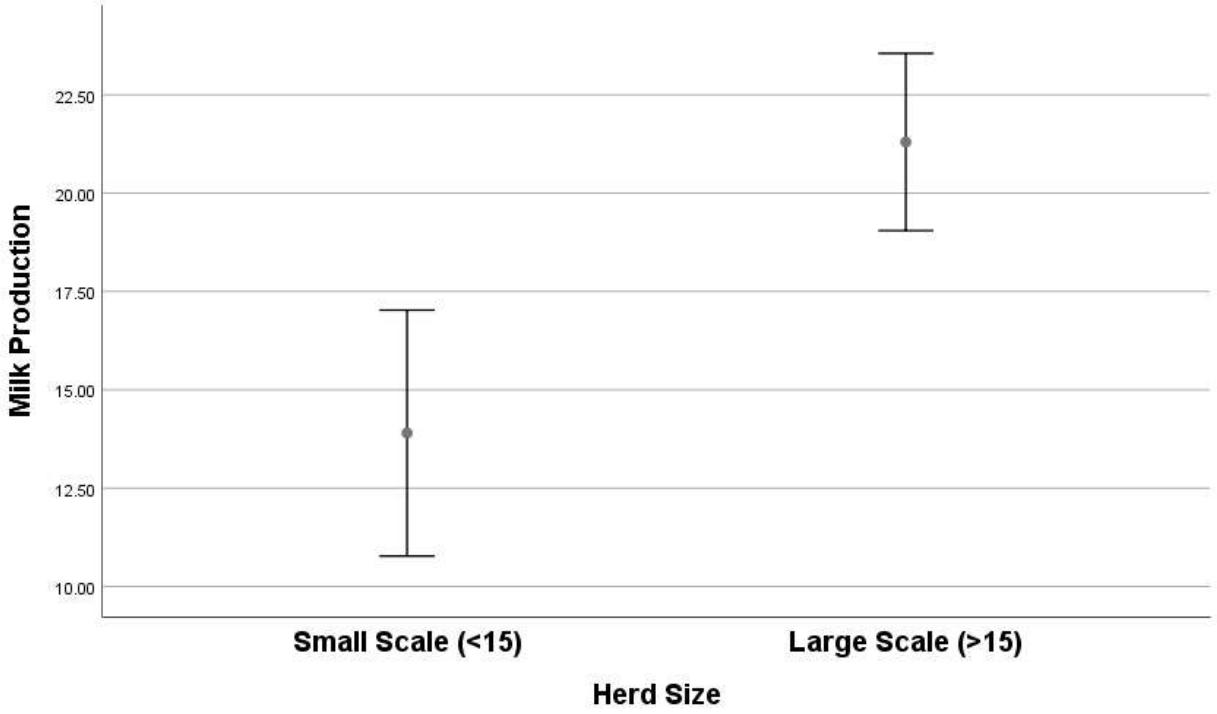

Figure 7 Relation Between Milk Production and Herd Size

Record Keeping

Based on the interview with an extension officer, farmers in Githunguri received training on appropriate record-keeping techniques. This claim was supported by the survey result that looked at whether or not farmers maintain records. The surveys' findings showed that a sizeable portion, particularly 74% of both farmer groups confirmed that they keep records. Most of the large-scale farmers' (47% out of 50%) indicated that they constantly maintain farm records. On the other hand, 27.5 % of the small-scale farmers highlighted that they implement record keeping.

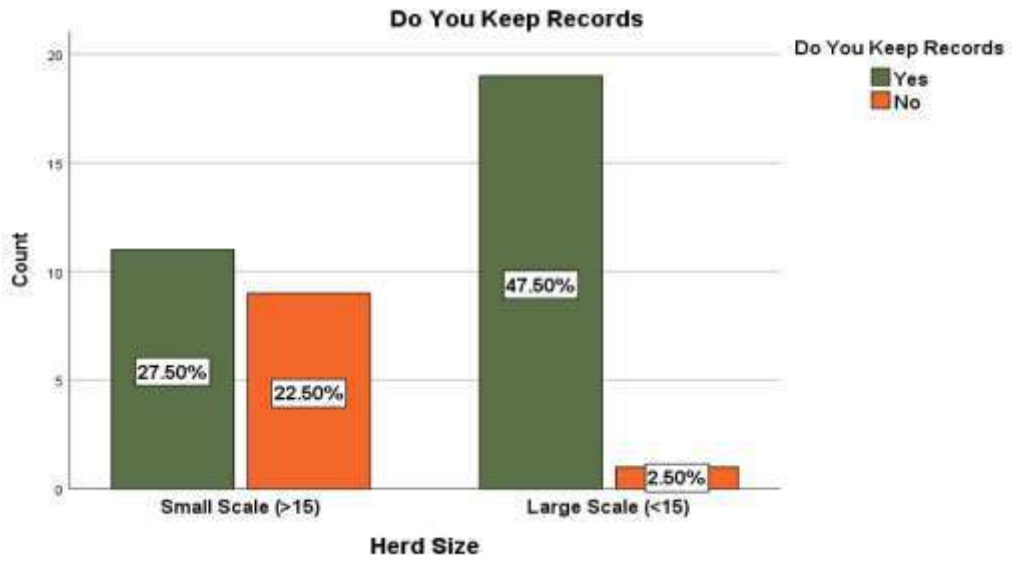

Figure 8 Record Keeping

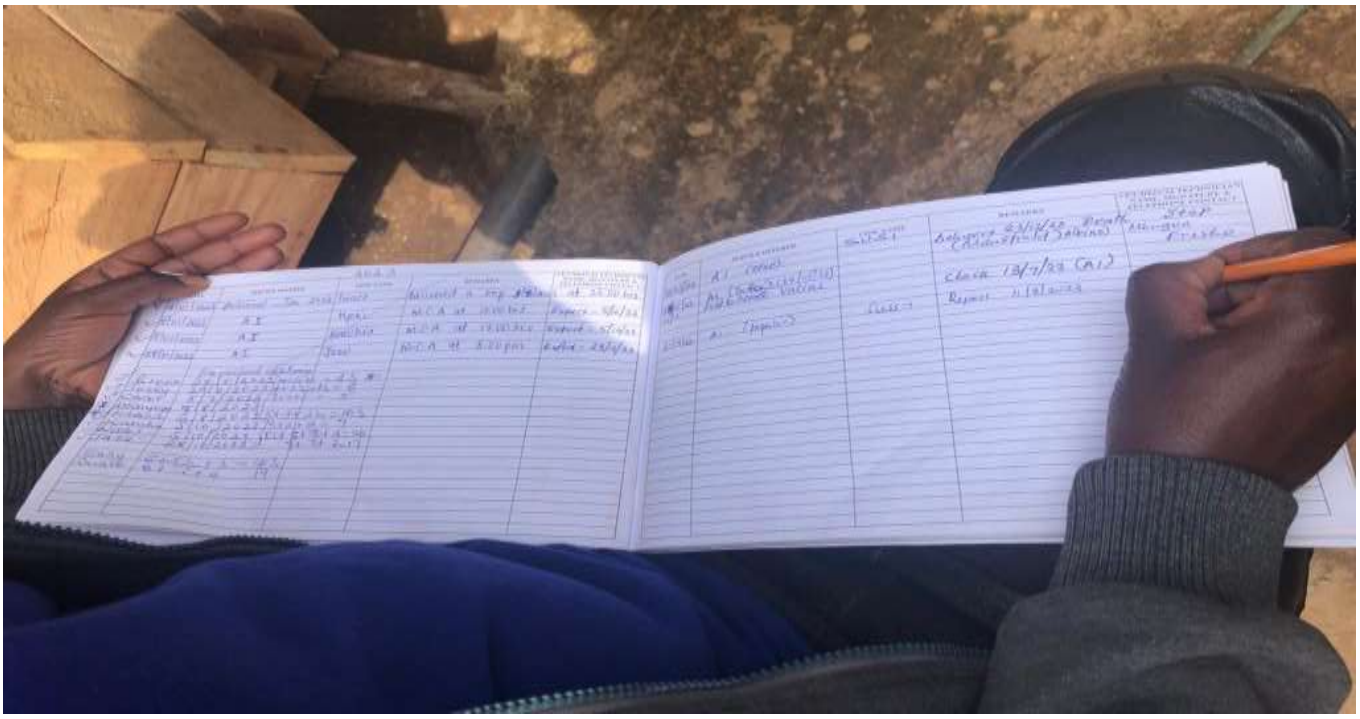

Figure 9 A farmer Filling Record Book

Regarding the type of records, respondents were different, some of them pointed out that they only keep production alongside either (health, breed or feeding) records while others maintain all the data related to their farm production. A substantial number (60%) of the large-scale participants indicated that they actively maintain records of production, health, breed and feeding. Therefore, it is easy for such farms to trace back if a need arises, for instance; disease incidences, withdrawal period, milk rejection cases etc., or when interventions are required. In addition, 30% of large-scale and 20% of small-scale reported that they keep records encompassing both production and health information on their farm. 15% of each farmer group indicated that they maintain both production and breed records, not health and feeding records.

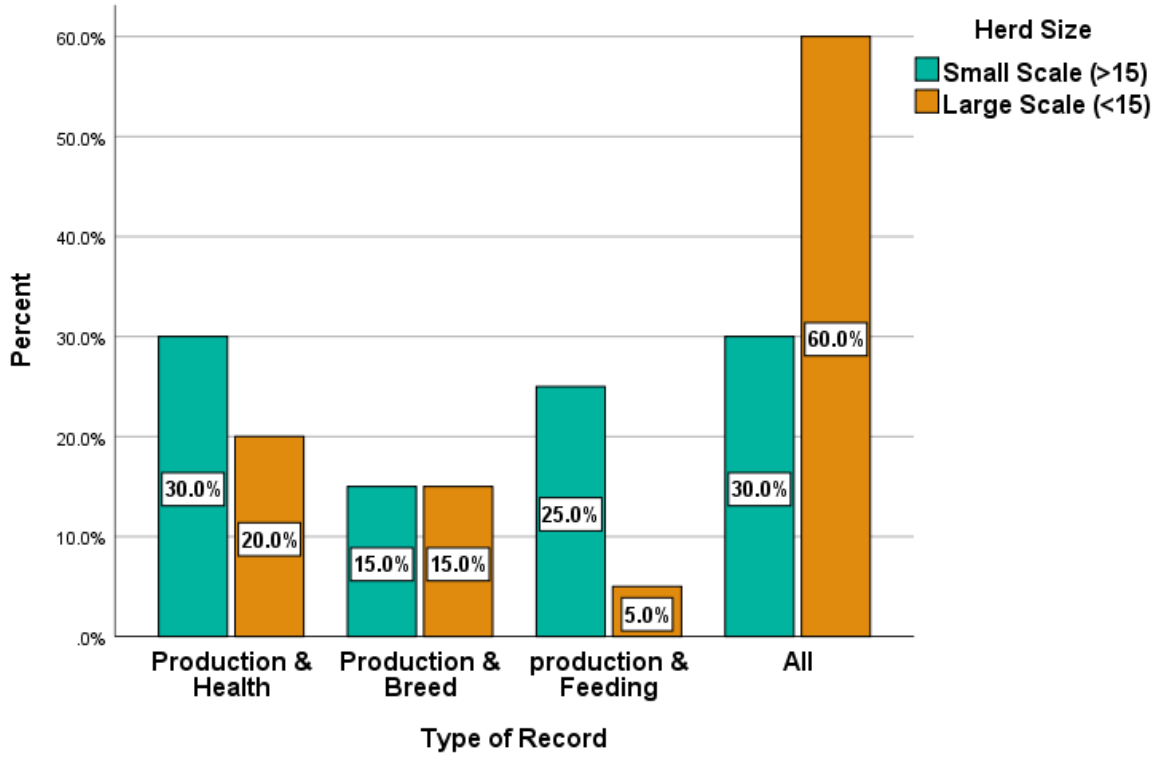

Figure 10 Type of Records Farmers' Maintain

4.2 Perception of the Farmer's about QBMPS

To assess farmers' perception of the quality payment system a survey was conducted of 40 farmers. The farmers were grouped into two sub-clusters, small-scale which has less than 15 animals and large-scale which has more than 15 animals.

4.2.1 Understanding of the QBMPS:

During the survey, farmers were requested to classify their comprehension understanding level of the quality payment system into three categories: 'limited' indicating a lack of understanding, 'moderate' indicating partial knowledge, and 'extensive' indicating a comprehensive understanding of how the QBMPS functions. The bar chart presents a comprehensive overview of responses from both farmer

groups. Particularly, 32% of small-scale and 25% of the large-scale rated their understanding as limited. Furthermore, 12.5% of the large-scale farmers classified their understanding as "extensive", signifying a deeper understanding of the systems' detail. In contrast, none of the small-scale farmers reported a similar level of understanding. This reveals a notable difference in terms of familiarity with the QBMPS among farmer groups.

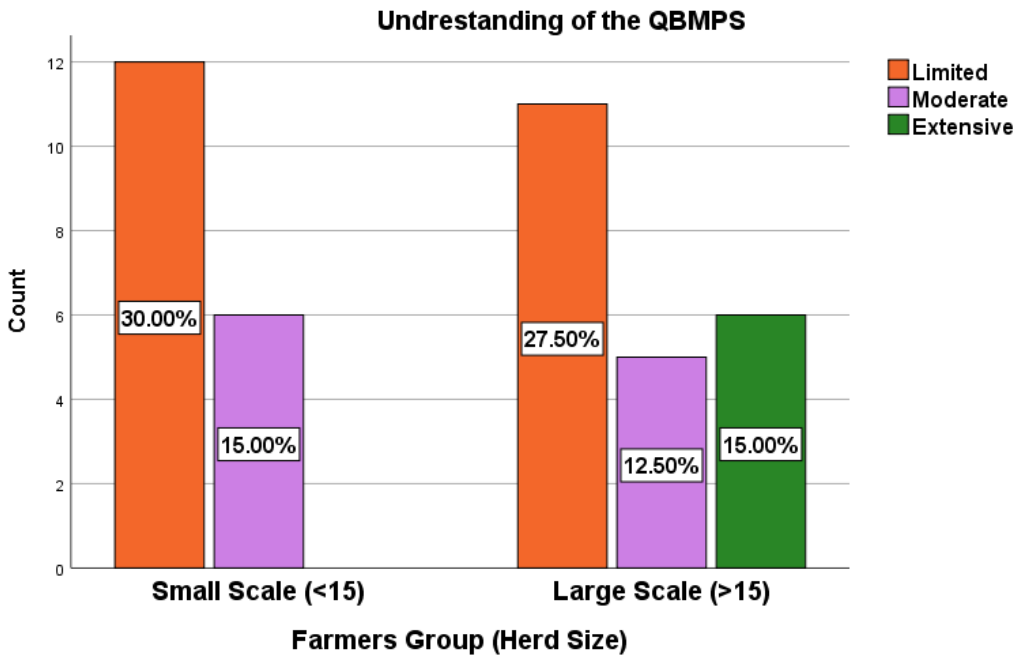

Figure 91: Farmers Understanding of the QBMPS

4.2.2 Willingness to Adopt QBMPS:

Figure 12 shows a perceptive of the attitude of both large and small-scale farmers regarding their willingness to adopt QBMPS. Among the survey participants, 40% of the large-scale respondents replied as very willing to adopt QBMPS, while 20% of the small-scale farmers recorded similar willingness. Although the awareness and knowledge of the system among the members was recorded as limited, in terms of willingness to adopt seems to have some interest from both groups. However, 7.5% of both groups expressed as not willing to implement the quality payment system. This highlights the fact that a relatively small but observable number of farmers from both categories expressed a lack of enthusiasm for the implementation of QBMPS into their operation.

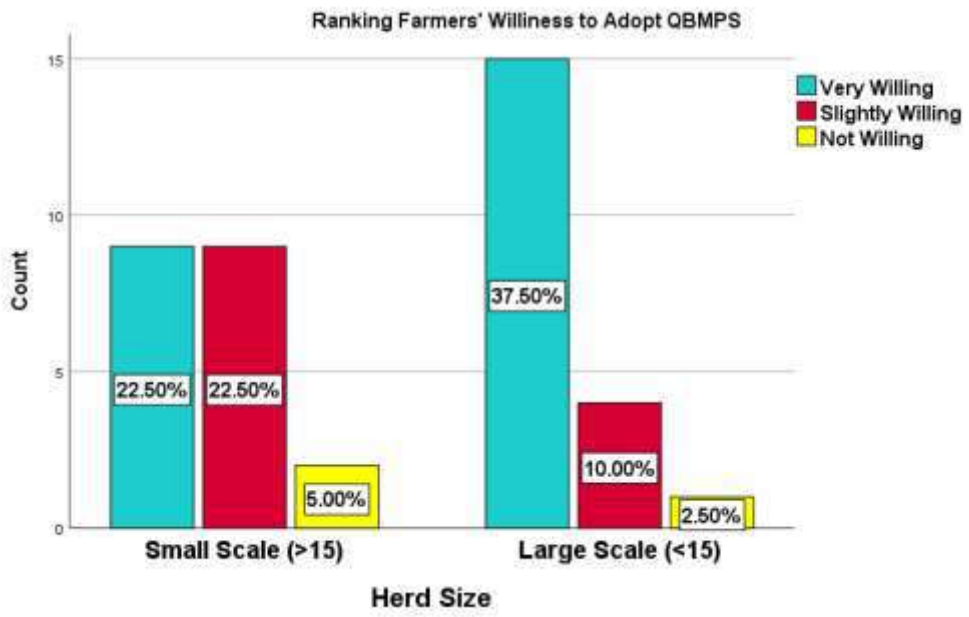

Figure 12 Willingness of Farmers to Adopt QBMPS

4.2.3 Reason for Milk Rejection:

Figure 13 indicates the primary reasons for the milk rejection according to survey participants. A significant number of farmers (47.5%) identified mastitis as the main reason causes their milk to be rejected from the cooperative. Subsequently, 22.5% of the respondents indicated antibiotic due to mastitis as also another main reason, followed by aflatoxin and alcohol positive which recorded 7.5% each as additional factors leading to rejection.

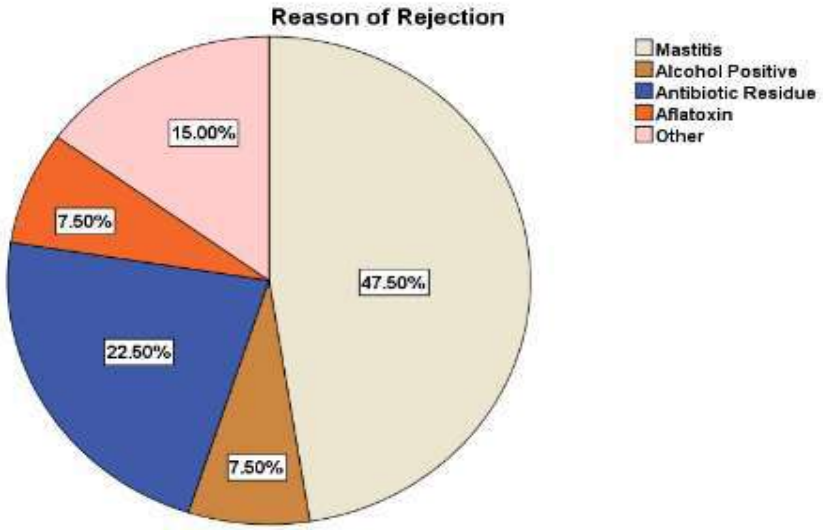

Figure 13 Reasons of Milk Rejection

4.2.4 Uses of Rejected Milk:

The pie chart demonstrates the distribution of various approaches used by farmers to handle the rejected milk. The majority of the participants, 60% replied that they fed the rejected milk to other animals (calf, dog and pig), while 22.5% sold it aside to extract some income and 17.5% they discarded the rejected milk altogether.

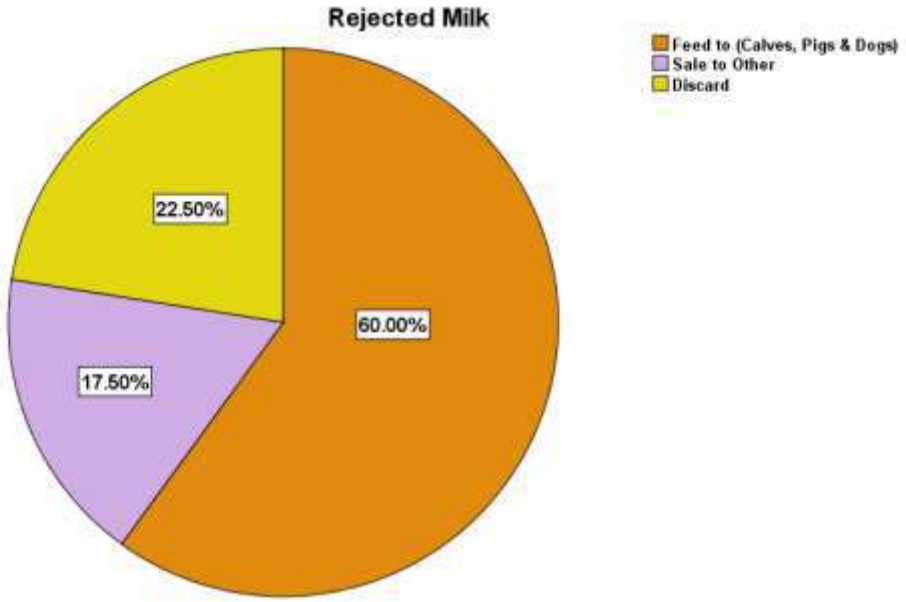

Figure 14 Uses of Rejected Milk

Section B Result from the Interview and Focus Group Discussion

4.3 Current quality parameters that GDFCS adopt:

The GDFCS (Githinguri Dairy Farmers' Cooperative Society) adheres to a rigorous set of quality parameters that are precisely tested on the milk collected from its members. These tests are conducted at three different locations within the dairy supply chain. Firstly, some tests take place at the collection centres, where farmers initially bring their milk. Secondly, additional assessments are performed at the cooling centres, where the milk is bulked and cooled before further processing. Finally, the most critical examination is carried out at the main processing plant, where the milk undergoes various stages of production to become final dairy products.

The testing process involves two distinct phases, depending on the nature of the specific tests. Some assessments require individual analysis, where the milk samples from each farmer are separately tested to assess their quality and adherence to safety standards. These individual tests are particularly important to identify any potential issues that may arise from specific farms and allow for targeted improvements in the milk production process. On the other hand, certain tests are specifically designed to be conducted after the milk is combined or bulked together. By conducting tests on the bulked milk, the cooperative ensures that the overall quality of the milk meets the required standards for large-scale production.

The organoleptic tests are used to identify any milk batches that might be compromised in terms of taste, smell, or appearance. By promptly identifying such batches, corrective actions can be taken to prevent subpar milk from entering the distribution system. In the context of Githunguri, the current procedure entails conducting fat and protein tests after the aggregation of milk batches, rather than assessing individual milk samples. To align with the QBMPS framework, the cooperative in Githunguri must make changes to guarantee that milk content tests, particularly focusing on fat and protein, are conducted at the collection points, including both mobile units and designated centres. This strategic change would improve the precision and accuracy of evaluating milk quality, aligning with the QBMPS standards and facilitating informed decision-making at the collection stage.

Table 7 Tests carry out at farm level, collection, cooling and plant centres

Tests	Where	How	Normal Range
Organoleptic	All	Individual	Clear-Normal
Alcohol	Collection Center	Individual	Negative
Density at 200C	Collection Center	Individual	1.27-1.34
Mastitis	Farm Level	Individual	Negative
Ph	Processing plant	Bulking	6.6-6.8
Aflatoxin	All	Individual, Bulking	<0.5ppb
Neutralizer	All	Individual, Bulking	
Resazurin	Cooling Center & Processing Plant	Bulking	Blue, Light Blue & Purple
Fat	Processing Plant	Bulking	Min 3.25 %
SNF	Processing Plant	Bulking	Min 8.5 %
Protein	Processing Plant	Bulking	Min 3.2 %
Total plate count	Processing Plant	Bulking	Max 2,000,000 cfu/ml
Antibiotic residue	All	Bulking	Not more than 10ppb
Somatic Cell Count	Processing Plant	Bulking	Max 300,000
Bacterial Load	Processing Plant	Bulking	
Coliform			Max 50,000 cfu/ml

Source: adopted from KATARAMA (2022) and expanded by the author

GDFCS Milk Value Chain:

The milk value chain in Githunguri is a well-integrated chain from the initial stage of production to subsequent processing and eventually retailing. The cooperative provides a range of significant services for instance; AI, extension and training, feed store, and consultation in feed and feed formulation, farm hygiene, animal welfare and treatment of mastitis. In addition, a remarkable foundation of this value chain are the quality parameters which stands as safeguarding measure to ensure the safety of the fresh milk and dairy products as well. When specific quality parameters fall under the standard, the concerned milk is promptly rejected, reflecting GDFCS' unwavering dedication to maintaining elevated quality standards. On the other hand, some other quality violation results in rejection and penalty, incidence of adulteration are one such example. This strategy promotes an accountability culture and supports the excellence criteria that characterize the Githunguri dairy value chain.

After rejection, a well-structured reporting system is in place, where the appointed grader promptly informs the responsible extensions who subsequently pay a visit to the farm and conduct a comprehensive analysis of the health status of the cows, the quality of the feed and general hygiene of the herd. This stringent examination strengthens the cooperative dedication to quality assurance which covers animal welfare and farm management issues. The payment is done on the fifth of each month and all the service costs and incurred penalties are systematically deducted from the respective farmers' payment. Moreover, the cooperative has its own processing plant and small shops for selling dairy products at wholesale prices.

GDFCS Value Chain Map

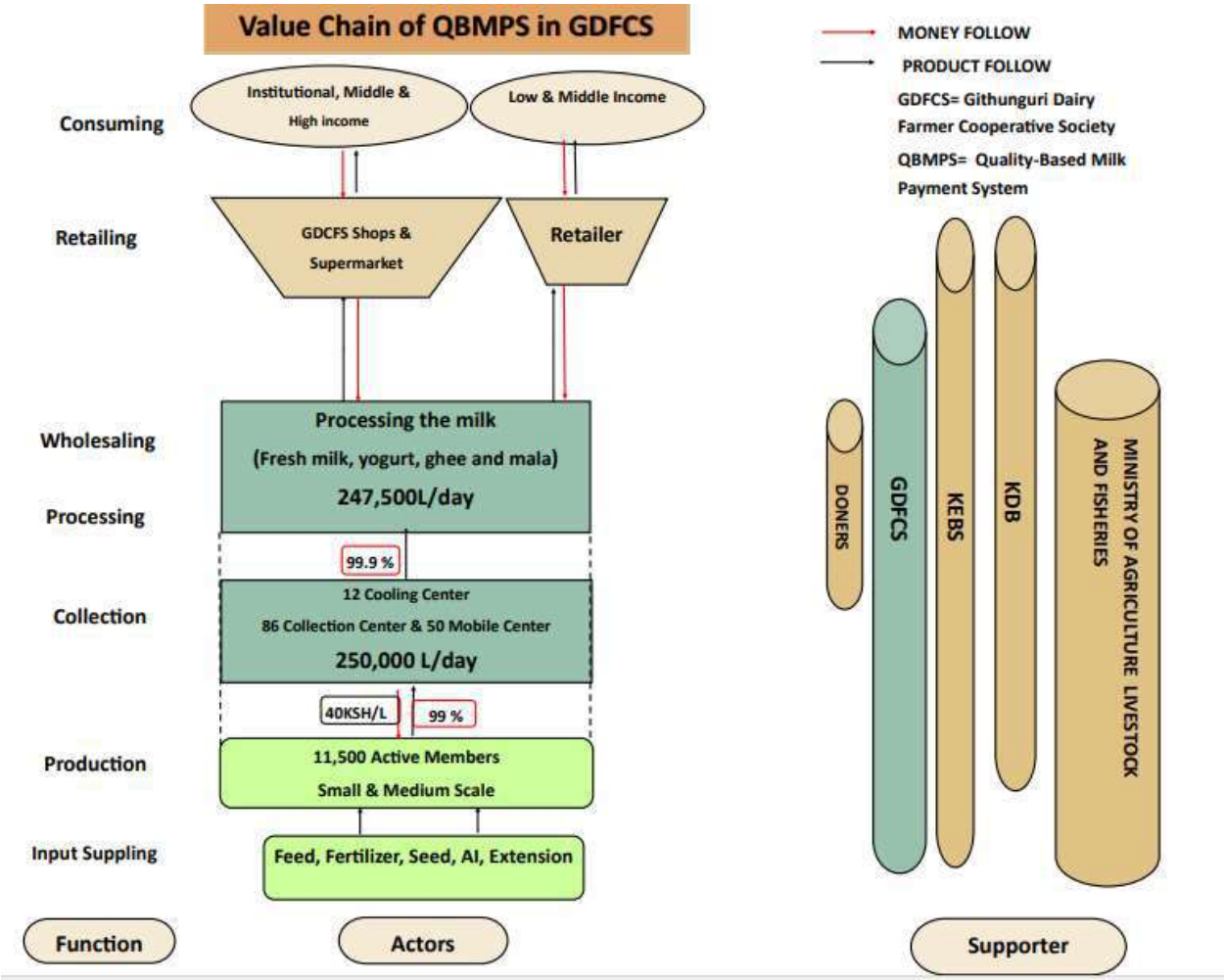

Figure 115 GDFCS Value Chain Map

Source: Author

Stakeholder Analysis:

ACTORS	ROLE
INPUT SUPPLIER	**Supply inputs**
PRODUCERS	**Members in the cooperative and continuously supply their milk to the cooperative.**
COLLECTION	**Githunguri cooperative bulks the milk in their collection and cooling centers.**
PROCESSOR	**The Githinguri cooperative owns processing company named Fresha, produces fresh milk, value added products like; yogurt, ghee, mala and butter.**
RETAILOR	**Wholesale and small shops**
CONSUMER	
SUPPORTERS	
KALRO	**A research institute contributes the development of agriculture and livestock through conducting research to solve the sector challenges and provide an innovative solutions for the both sectors.**
KDB	**The legal body which is responsible the regulation, promotion and development of the dairy sector in Kenya.**
MALF	**Ministry of Agriculture Livestock, Fisheries and Cooperatives formulate, implement and monitor the agricultural legislations, regulations and policies.**
NEMA	**Monitor and assess activities, including activities being carried out by relevant lead agencies, in order to ensure that the environment is not degraded by such activities.**
KEBS	**mandate to promote standardization in industry and trade through standards development, conformity assessment, testing and metrology.**

Milk Rejection Rate:

GDFCS conducted a comparison of rejection rates for the last two years. the report indicated an increase in the rejection rate at the beginning of this year (March 2023) and it reached it is a peak of 0.07% of the total intake amount of milk. The report indicated incidence of mastitis and adulteration as the main reasons for the rejection during that period.

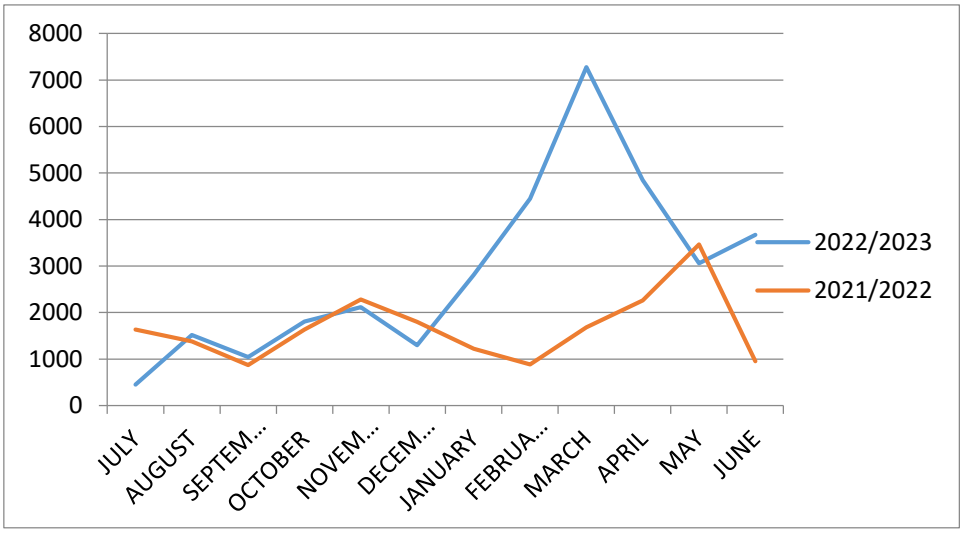

Figure 126 Monthly Milk Reject Trends (2022-2023)

Source: GDFCS Report (2023)

4.4 Drivers of the cooperative to adopt QBMPS

During the interview with the quality manager, deputy of the processing plant manager and three quality inspectors, a ranking form was generated to identify the main drivers that GDFCS pushes to adopt the QBMPS. These members were requested to rank the drivers and the result is shown in figure 17. It illustrates that both economic and political were the main drivers of the cooperative towards the adoption of a quality-based milk payment system.

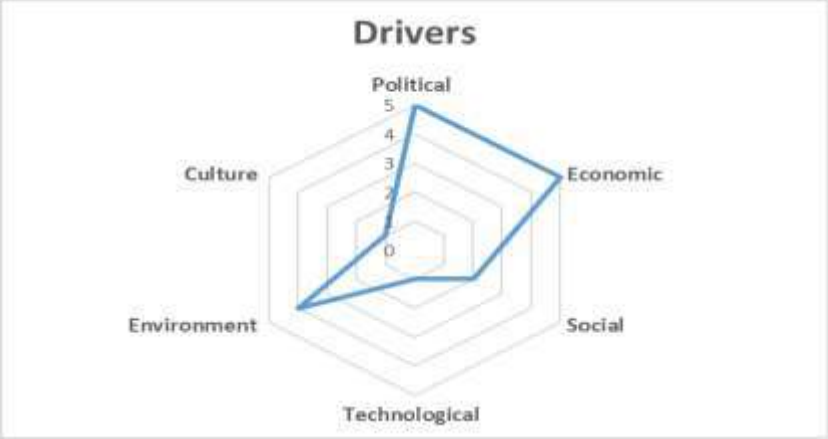

Figure 13 Drivers of GDF Cooperative to Implement QBMPS

Furthermore, an alternative parameter was generated in order to evaluate the primary motivator driving the adoption of a quality system within GDFCS. Figure 18 presents 6 drivers namely; the concern of milk quality, the simple implementation of the system, market competitiveness, farm sustainability, economic incentives and transparency and fairness that the system incorporates. Among these six drivers, concern for quality, implementation and farmers' incentives were identified as very influential drivers. In addition, market competitiveness was also identified as moderately influential. However, farm sustainability and transparency of the system are highlighted as not influential drivers.

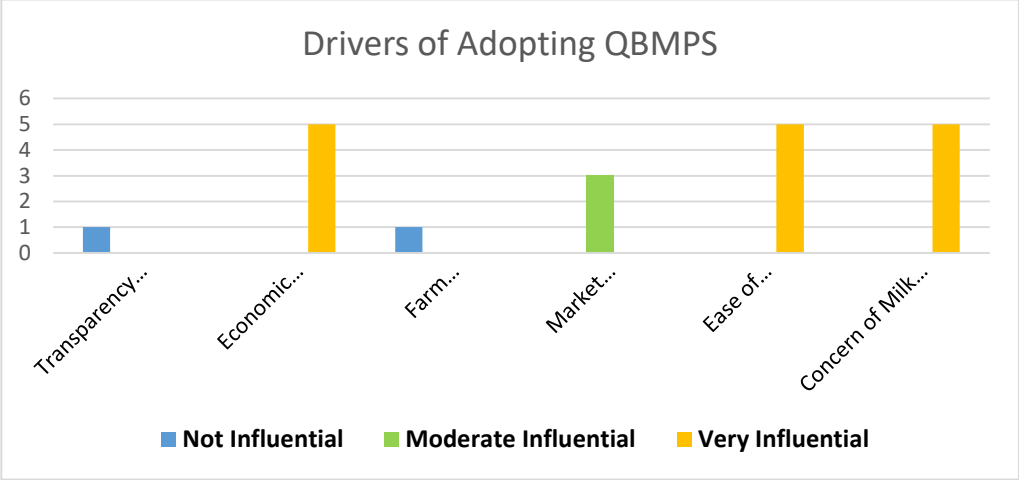

Figure 14 DRIVERS-2 OF GDFC to Adopt QBMPS

This was strengthened by the two processing managers, who showed more willingness to adopt the quality system as long as the system incentivizes farmers to supply good quality and compensate for their efforts. As a result, receiving high-quality raw milk will reduce the cost of the supplementary products that are required to be used during the processing of high-quality products like yoghurt. At the same time, a quality-based milk payment system allows processors to make premium products like cream, butter, and ghee.

4.5 Effects of adopting QBMPS:

Implementing a quality-based milk payment system like any other system has positive effects and drawbacks on the society or the cooperative members. Therefore, pre-assessment of the effect of the system is crucial. This section presents the perspective of different key informants in the dairy value chain. The effect combines both farmer's and cooperative costs and benefits.

4.5.1 Effect of adopting QBMPS on farmers' income

According to the interview with the key stakeholders, a quality-based milk payment system has a positive effect on the farmers' income and their profitability while also improving market access and demand. Additionally, it promotes environmentally friendly methods, improves technical expertise, reduces waste, and fosters a competitive advantage in the market. They also highlighted the potential challenges during

the implementation of quality-based milk payment systems such as costs, resistance, and traceability issues, especially within smallholder systems.

Through a focus group discussion, a total of 10 farmers were requested collectively to discuss several aspects of the quality-based milk payment system, shedding light on both the advantages and potential drawbacks of this approach and their knowledge of the system. Members were grouped into two groups (5 in each group) and were given a flipchart to write down the benefits and costs of QBMPS comparing the volume system that currently is implemented. Each group presented a list of the costs and benefits of QBMPS and discussed it together with the other group. Table 8&9 summarizes farmers' deliberation about the cost and benefit of adopting QBMPS according to farmers' perceptions.

Table 8 Benefits of Adopting QBMPS (farmers' perspective)

	Benefits of Adopting QBMPS	**Description**
1.	Increased Income and Profitability	A quality-based payment system incentivizes farmers to produce higher-quality milk, which often fetches a better price in the market. This leads to increased income and higher overall profitability for smallholder farmers.
2.	Quality Improvement Incentives	By rewarding farmers for delivering higher quality milk, the system encourages farmers to focus on improving the health and nutrition of their cattle, hygiene practices, and overall dairy farming techniques to meet the quality standards.
3.	Market Access and Demand	Quality-assured milk is more likely to meet market requirements and gain access to better markets (export market).
4.	Consumer Confidence and Brand Value	A reputation for supplying quality milk can enhance consumer confidence in the dairy products originating from smallholder farmers.
5.	Sustainable Practices Adoption	The quality-based payment system can encourage smallholder farmers to adopt sustainable agricultural practices that improve milk quality, such as proper animal nutrition, and better farm management practices.
6.	Technical Knowledge Enhancement	Farmers are likely to seek knowledge and guidance to improve milk quality to meet the requirements of the quality-based payment system. This can lead to increased access to training, technical support, and information on best practices.
7.	Empowerment and Decision-Making	As farmers gain knowledge and understanding of quality standards, they become empowered to make informed decisions about their farming practices, enabling them to tailor their activities to meet the quality requirements.
8.	Reduced Waste and Losses	A focus on delivering quality milk often results in better handling and storage practices, reducing milk spoilage and waste. This translates to higher utilization of the produced milk and reduced economic losses.
9.	Enhanced Sustainability and Market Positioning	Emphasizing quality fosters sustainability in the dairy farming sector. Smallholder farmers who produce quality milk are better positioned in the market, attracting investors and potential partners interested in supporting sustainable practices.

10.	Competitive Advantage and Differentiation	By consistently supplying high-quality milk, farmers and their cooperative can gain a competitive advantage in the market. This differentiation can open up opportunities for better pricing and business growth.

Table 9 Costs of Adopting QBMPS (farmers' perspective)

	Cost of Adopting QBMPS	**Description**
11.	Initial Financial Burden	The transition to a quality-based payment system may require significant initial investment in infrastructure, technology, and training, posing a financial burden on already resource-constrained smallholder farmers.
12.	Technical Skill Requirements	The system demands a certain level of technical skills and knowledge regarding milk quality standards, which may necessitate training and capacity building for farmers, potentially incurring additional costs.
13.	Compliance Costs	Meeting the stringent quality standards for payment may require farmers to invest in improvements to their farming practices, infrastructure, and animal care, leading to increased operational costs.
14.	Risk of Economic Penalties	Failure to consistently meet quality standards can result in economic penalties or reduced payments for farmers, affecting their overall income and financial stability.
15.	Market Exclusion for Non-Compliance	Farmers struggling to meet the quality requirements might face exclusion from certain markets or buyers, limiting their selling options and potentially reducing their income opportunities.
16.	Potential Income Fluctuations	As the payment is directly tied to milk quality, smallholder farmers may experience income fluctuations due to variations in milk quality, impacting their financial predictability and stability.
17.	Resource Intensiveness for Compliance	Complying with the quality standards could demand additional resources, such as more labor, time, and inputs, which may strain the limited resources of smallholder farmers.
18.	Adaptation Challenges	Adjusting farming practices and operations to meet the requirements of the quality-based system may pose challenges for farmers, especially those accustomed to traditional volume-based approaches, requiring time and effort to adapt.
19.	Equity and Fairness Concerns	There may be concerns about the fairness of the quality-based payment system, especially if it disproportionately benefits larger or more financially stable farmers, potentially exacerbating existing inequalities within the farming community.

A ranking form was also developed to assess the effect of adopting a quality-based milk payment system on farmers' income and to evaluate the cost and benefit of implementing such a system. The form presented measurements and requested farmers to scale from 1-5, where 1 indicated low impact and 5 indicated high impact.

The chart illustrates an interesting difference between the two groups of farmers. Group 1 showed notable propensity, with their highest score attributable to the measurement of an increase in milk price. In contrast, group 2's highest score leaned toward market access. However, it is significant that both groups registered the lowest score for the fairness of compensation within the quality-based payment. The farmers' collective answer suggests a prevalent attitude of doubt against the idea that the proposed quality-based milk payment system compensation strategy will fairly and appropriately compensate their sincere efforts. This inconsistency in perceived fairness may be due to underlying worries or uncertainty about how the quality-based payment system will be feasible.

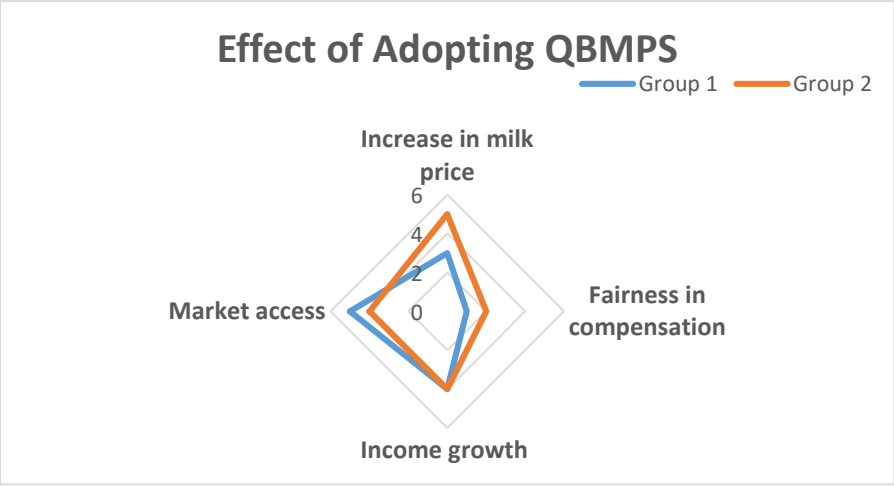

Figure 15 Effect of Adopting QBMPS According to Farmers' Perspective

4.5.2 Effect of adopting QBMPS on the cooperative (Cost and Benefit)

The graders and quality assurance highlighted the quantity of milk supplied by the farmers, the cost of the test and the demand to hire extra staff as significant challenges in the implementation of a quality-based milk payment system. According to the milk inspectors the low volume of the milk supplied by small-scale farmers, carrying out the tests separately will be time-consuming and consequently predispose to milk spoilage. Some tests that currently are done after bulking will require to be done individually which increases the operational cost of the cooperative society. KALRO emphasize the improvement of milk quality through the development of diverse fodder and forage species, coupled with animal health and welfare training. The expert from KALRO expressed that milk quality in Githunguri is not an issue, however, the main problem is a land shortage that affects feed production, herd size and the demand of farmers to purchase feed from other counties.

It was proposed to introduce diversified feed sources for the enhancement of both volume and productivity and Cooperatives' involvement in fodder production. Marketing premium milk is a suggested pathway to improve quality and livelihoods. In addition, the establishment of a distinct value chain for quality-based milk payment is full of dedicated actors and premium incentives. Government participation in extension services, antibiotic utilization, and cooperation with national dairy organizations are also emphasized. Due to their resource advantage, large-scale farmers are highlighted as initial participants in quality-based payment systems, with the potential for positive spillover effects on cooperatives and value-added product outcomes.

Figure 16 Photos during Focus Group Discussion

Source: Field data, 2023

4.6 Assessing Readiness Level of GDFCS for adopting QBMPS:

A readiness level ranking matrix was developed in order to assess the level of preparedness of the cooperative to implement the system. The ranking matrix was filled by five staff members from the cooperative who participated in the study as key informants during the interview (Table 4). The score was from 5-0 with 5 standing as the highest capacity of readiness while 0 stands as the lowest capacity. The matrix comprises some criteria for instance, availability of milk test and quality standards, previous quality records, the status of the cold chain, farmer's awareness and willingness, as well as the cost and benefit of QBMPS. According to the results, coop managers ranked the milk tests and the presence of quality records as they were in the highest preparedness level. The finding sheds light on that the cooperative has a considerable capacity in terms of these two measures to adopt an effective quality-based milk payment system.

The ranking matrix also revealed the feasibility of the cost and benefit of QBMPS and farmers' willingness to engage, ranked as the second level of readiness after (milk test and previous quality records) according to the quality manager of Githunguri cooperatives' ability. Although the QBMP system has a high cost, it provides an enormous benefit to the cooperative by reducing the cost of supplement product that is used during yoghurt production and also providing the possibility to extract an extra amount of fat from the milk. Farmers' willingness was also high as it was supported by the outcome of the questionnaire. However, the status of the cold chain and farmers' awareness was marked 3 and 2 respectively. Concerning the cold chain, it was reported the tracks used for transportation are not refrigerated, possibly jeopardizing the milk quality within the supply chain. In addition, the awareness of farmers about the quality system was low as it strengthened the findings from the survey.

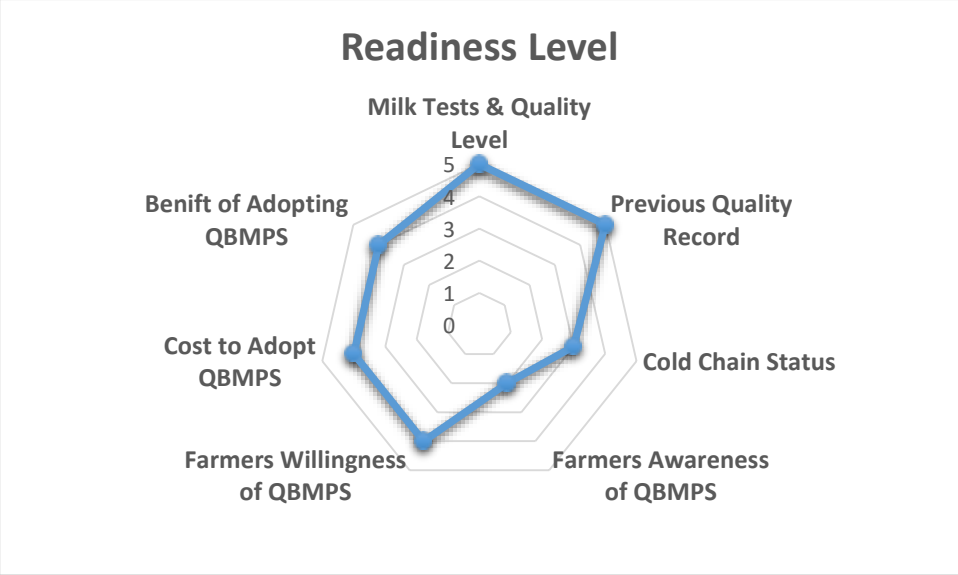

Figure 17 Ranking GDFCS Readiness Level to Adopt QBMPS

Figure 13: Different Activities at GDFCS

Graders scaling the milk

Cutting Napier Grass

Farm hygiene Status (Manure mismanagement)

Communication Box (Farmers leave their message)

Figure 18 Photos of Different Activities in the Field

Source: Author during field visit

CHAPTER 5: DISCUSSION

This chapter presents the discussion of the outcomes of the research conducted in the Githunguri sub-county, involving a survey with 40 farmers, 1 FGD and 10 interviews with key informants in the dairy value chain. The discussion is organized according to the research sub-questions to provide answers to those questions.

5.1 Respondent Profile:

The results of this study provide information on the demographic and educational backgrounds of Githunguri dairy farmers. In terms of gender, the majority of the respondents (60%) were male whereas the remaining (40%) were female. The age distribution is also fairly interesting. A noteworthy number (90%) of the respondents were over the age of 30 while only 10% fell into younger age (30) criteria. This was also reported by Katarama (2022) and Kiiza (2018), who found the dominance of males in the dairy sector in Githunguri, and over 67% of both studies, participants were aged above 36 years. This shows the dominance of the older people in the milk value chain and less engagement of young age in the sector. The long-term sustainability and innovation may be affected by the under-representation of younger people in this industry. For the industry to remain vibrant and continue to thrive, it may be crucial to promote young involvement and provide them with possibilities inside it.

Furthermore, considering farmers' education level most of them had attained a higher level of education, university, diploma and high school certificate with percentages of 33%, 10% and 52% respectively. However, only 5% of the surveyed members mentioned that they have a primary school certificate.

5.2 Current quality parameters:

The GDFCS adopts several quality parameters to confirm the safety of the milk value chain. The cooperative ensures the production of safe and high-quality dairy products, contributing to the happiness of its members and consumers while upholding a solid reputation in the dairy business. According to Ndambi et al. (2020), some East African nations, like Kenya, concentrate on the nutritional components of milk, such as protein, fat, casein, and lactose, others, like Zimbabwe and South Africa, have a common problem with mastitis prevalence and microbial presence, so they consider SCC and TBC (Özkan Gülzari et al., 2020). In Uganda, a pilot study was conducted to implement QBMPS and the main quality parameters was butter-fat and SNF (SNV., 2017).

The tests are done at three different locations for instance; collection centres, and cooling centres and the main tests are done at the processing plant. Due to the high cost of several tests, for instance; resazurin test, SCC, TBC and milk composition tests are conducted after bulking the milk supply either at the cooling centres or at the processing plant. Botero et al., (2013), conducted a study to estimate the relation between SCC, TBC, fat and protein with QBMPS in Brazil. They found that a quality-based milk payment program was associated with a reduction in somatic cell count (SCC) and total bacterial count (TBC) in milk, indicating improved milk quality. The standard of GDFCS tests is in line with the KDBs' standards and continuously is reported to the quality officer.

The organoleptic tests allow prompt identification of compromised milk to take immediate corrective action and maintain the reputation of the cooperative society for consistently providing high-quality dairy products. The alcohol test acts as a quality control measure to stop milk from being contaminated or adulterated before it enters the cooperative society's processing system. Any alcohol presence can indicate poor management, contamination, or adulteration. For the safety and happiness of the consumer, milk must be free of alcohol. Milk that has been exposed to alcohol may lose its flavour, quality, and safety, rendering it inappropriate for eating and further processing. For traceability purposes, the alcohol test results are recorded. This documentation enables accountability throughout the supply chain and aids in tracking the quality of milk batches. The milk inspectors and graders of GDFCS are instructed in the proper use of the alcohol gun.

The cooperative exhibits its dedication to ethical dairy operations by giving consumer safety and concerns about antimicrobial resistance top priority. A thorough assessment of test findings guarantees that any milk sample that contains antibiotic residues above the prescribed thresholds is quickly identified, preventing it from entering the supply chain. By implementing this cutting-edge testing strategy, the Githinguri Dairy Farmer Cooperative Society demonstrates its dedication to upholding the highest milk quality and safety standards, further fostering consumer confidence. According to (Riveros-Galán & Obando-Chaves, 2020; Winter et al., 2003), it is crucial to place somatic cell count (SCC) and total bacterial count (TBC) as criteria for the milk quality-based payment, as these parameters are internationally recognized indicators of milk quality.

The Githunguri Dairy Farmer Cooperative Society (GDFCS) places a strong emphasis on ensuring safe and high-quality dairy products through rigorous quality parameters. Their commitment involves conducting comprehensive tests at various stages of the milk value chain, including collection and cooling centres, with major assessments performed at the processing plant. These tests encompass composition analysis, somatic cell count (SCC), total bacterial count (TBC), and organoleptic evaluations. The cooperative also implements an alcohol test to prevent milk contamination and maintain milk quality. Notably, GDFCS is dedicated to ethical dairy operations, promptly identifying antibiotic residues in milk samples to prevent their entry into the supply chain, in alignment with prescribed thresholds. Overall, their stringent testing practices and dedication to milk quality and safety uphold a solid reputation and instill consumer confidence, aligning with international milk quality indicators.

5.3 Drivers of Githunguri cooperative for adopting QBMPS:

Due to a number of drivers, the Githunguri Dairy Farmers Cooperative Society is eager to put into place a quality-based milk payment system. These include the cooperative's commitment to enhancing milk quality for consumer satisfaction, fair compensation to members based on quality, market competitiveness through premium products, adoption of sustainable practices, meeting regulatory standards, member engagement, responding to consumer demand for quality, and ensuring the cooperative's long-term viability by encouraging continuous improvement. These drivers collectively contribute to the cooperative's aim of delivering safe, high-quality dairy products, maintaining its competitive edge, and establishing a sustainable and successful presence in the dairy industry.

The cooperative's unwavering dedication to improving milk quality stands out as the primary motivator for this tactical change. Ton et al., (2016) highlighted that the successful implementation of the quality-based milk payment systems relies on effective quality assurance systems and cost-efficient payment modalities for cooperative members. The cooperative aims to assure customers' happiness by putting quality first. The necessity of this attempt is highlighted by the knowledge that consumers are demanding dairy products of higher quality. By upholding strict quality standards, the cooperative not only complies with legal requirements but also keeps up with the changing demands of its customers

Adopting a quality-based payment system also provides a method for ensuring that its members receive fair compensation. Based on the quality of milk given, such a system rewards farmers for their efforts to produce better milk. This fair remuneration structure encourages members to improve their milk production practices while also promoting collaboration and a sense of fairness within the cooperative.

Additionally, the cooperative's choice is consistent with the competitiveness and broader market dynamics. The cooperative's position in the market can be strengthened through the launch of premium dairy products built on high-quality milk. The cooperative can carve out a niche for itself by catering to customers who appreciate quality, possibly commanding higher prices and gaining a sustained market share. A research by Fuentes et. al (2016) in Peru, highlights that the importance of selecting market opportunities and designing milk payment systems to encourage farmers to supply good quantity and quality milk. According to Pieniadz (2007), the rate at which quality standards are adopted is influenced by market structure, input and product pricing, and both. High costs of compliance reduce standard adoption whereas big investments in the purchasing market promote it.

The sustainability of the dairy sector regarding milk quality and reduction of milk losses are also crucial to be considered. Adopting sustainable agricultural methods supports both national and international environmental concerns by reducing the carbon footprint and conserving natural resources. It is also important for the cooperative's long-term existence in order to minimize the cost and improve market access. The cooperative ensures the appropriate stewardship of resources, protecting the future of the dairy industry and its own sustainability by empowering smallholder farmers through education. A key element of this transformation is member engagement. The improvement of milk quality must have active member involvement under a payment structure based on quality. When members actively engage in a payment structure based on the quality of milk, they have a tangible stake in the cooperative's success. This members' sense of ownership and responsibility is fostered by this participation, which starts a positive cycle of ongoing progress.

The engagement of dairy farm cooperative members in adopting a quality-based milk payment system is a pivotal aspect that significantly contributes to the overall transformation of the cooperative and the improvement of milk quality. This engagement facilitates a symbiotic relationship between the cooperative and its members, underpinned by shared goals and a collective vision for enhancing the quality of milk produced.

Moreover, a quality-based payment system fosters a culture of continuous improvement within the cooperative. Members are more likely to engage in knowledge-sharing and adopt innovative approaches to improve milk quality when they see the direct correlation between their efforts and their earnings. This

collaborative learning environment enhances the collective knowledge base of the cooperative, leading to ongoing advancements in farming techniques, milk processing, and quality control measures. Furthermore, the engagement of members in a quality-based payment system cultivates trust and transparency. When members clearly understand the criteria for determining milk quality and subsequent payment, it builds transparency in the cooperative's operations. This transparency, coupled with a fair and equitable payment structure, enhances trust and confidence in the cooperative's leadership and decision-making processes.

The Githunguri Dairy Farmers Cooperative Society is driven to implement a quality-based milk payment system, aiming to enhance milk quality, fair compensation to members, and market competitiveness through premium products. This strategic change aligns with consumer demands for higher-quality dairy, encouraging farmers to improve their milk production practices. Additionally, sustainability and member engagement are prioritized to foster transparency, trust, and ongoing progress within the cooperative.

5.4 Smallholder farmers' expectations from adopting QBMPS:

In order to thoroughly evaluate farmers' perceptions of the Quality-Based Milk Payment System (QBMPS), both qualitative and quantitative methodologies were used in this study. Farmers were asked to rate how well they understood the QBMPS as part of the survey, which gave vital information on how familiar they were with it.

The survey found observable disparities between the farmer groups in their knowledge of the QBMPS. Both small-scale (30% out of the total 50%) and large-scale (27.5% out of the total 50%) farmers reported having a notable percentage of their understanding as being limited. Large-scale farmers, on the other hand, made up a distinct portion (15% out of 50%) who assessed their understanding as "extensive," indicating a deeper understanding of the complexities of the system. It's interesting to note that none of the small-scale farmers reported having a similar high degree of comprehension. This disparity reveals that different farmer groups have different levels of exposure to the QBMPS. Consequently, establishing of farmers' exchange group will play a crucial role in enhancing the interaction among members for knowledge and experience sharing.

The perspectives of both large- and small-scale farmers about their desire to implement the QBMPS are studied. 20% of the small-scale farmers which present 50% of respondents, reported a strong desire to implement the QBMPS, compared to a substantial percentage (40%) of the large-scale respondents (totaled the other 50%). Despite the members' reported limited awareness and knowledge of the system, both groups showed signs of interest in terms of desire to adopt after giving an overview of the system. The same result was reported by Kabui (2012), who found that a majority of farmers in Kenya would accept a payment system based on milk quality if there were appropriate incentives. Saenger (2013) conducted a framed field experiment in Vietnam and found that penalty and bonus payments for milk quality incentivized farmers to invest in quality-improving inputs.

However, a total of 7.5% of farmers in both groups (small and large-scale) expressed concerns about putting the quality payment system into place. This emphasizes the fact that both groups of farmers

contained a relatively small but noticeable proportion of farmers who lacked the motivation to implement the QBMPS into their businesses. This was supported by other research like; Ndambi et al., (2018) found that the reliance of farmers on the QBMPS was one of the main challenges during their pilot study. Nyokabi (2021) studied the knowledge, attitudes, and practices of smallholder dairy farmers in Kenya regarding milk quality and food safety. The study reveals low knowledge levels and negative attitudes towards milk quality standards and food safety regulations, emphasizing the need for improved knowledge and implementation of hygienic practices.

The results of the survey showed that an important proportion of farmers (47.5%) named mastitis as the main reason why milk was rejected. Mastitis can have a considerable negative influence on milk quality. Conducted in both Kenya and Ethiopia, a comprehensive study by Verschuur et al. (2021) shed light on the agricultural practices related to manure and biogas management, as well as rainwater harvesting among farmers. Surprisingly, the study found that just a small perecntage, less than 30%, of farmers in Githunguri have actively implemented measures to manage manure effectively, utilize biogas, and engage in rainwater harvesting initiatives. In the specific region of Githunguri, a considerable number of farmers struggle with challenges associated with managing manure on their farms.

The uncontrolled spreading of manure across the farms has emerged as a significant issue, negatively impacting the overall hygienic quality of raw milk. As a consequence, there has been a noticeable increase in both Total Bacterial Count (TBC) and Somatic Cell Count (SCC) percentages in the milk collected from these farms (Carloni et al., 2015). This alarming scenario underlines the urgency for better agricultural practices, emphasizing the proper management of manure, biogas utilization, and rainwater harvesting. Addressing these challenges is essential not only for the well-being of farmers and the sustainability of their operations but also for safeguarding the quality and safety of the dairy products that reach consumers' tables.

The use of antibiotics to treat mastitis was then cited by 22.5% of responders as another significant factor in milk rejection. Aflatoxin and alcohol positive were also mentioned by 7.5% of respondents each, which are additional causes of milk rejection. In Ethiopia, consumers are at risk from antibiotics and aflatoxin in milk, which was reported to cause health issues (Gizachew et al., 2016). These results highlight the necessity of targeted interventions and education about appropriate milking techniques, animal health management, and observance of advised withdrawal intervals following antibiotic treatment. Moreover, during the survey, the researcher encountered quite a few farmers employing preventative measures to reduce mastitis incidence. These farmers reported rare cases of mastitis on their farms. In such instances, establishing farmers' groups becomes pivotal for facilitating the exchange of experiences and knowledge among cooperative members.

The majority of participants (60%) admitted to giving the rejected milk to animals like pigs, dogs, and calves. This practice ensures effective utilization of the milk that is rejected as well as minimizing financial losses for the farmers. However, 22.5% of respondents decided to sell the rejected milk separately in order to make some money. A recent study carried out in Githunguri-Kenya, revealed comparable findings (Katarama., 2022). This strategy shows how farmers are making an effort to reduce the financial losses

brought on by milk rejection. Last but not least, 17.5% of participants mentioned completely discarding the rejected milk, highlighting the significance of good waste management techniques to avoid any adverse environmental impact. In the context of farm practices such as manure management as a climate-smart practice, a low percentage of farmers in Githunguri effectively manage their manure by utilizing it in a responsible manner.

The survey in Githunguri, Kenya, revealed differences in farmers' understanding of the Quality-Based Milk Payment System (QBMPS) between small-scale and large-scale farmers. Large-scale farmers demonstrated a deeper understanding of the system, indicating varying levels of exposure to QBMPS across farmer groups. A farmers' exchange group is essential to enhance knowledge sharing. Despite limited awareness, both groups showed interest in implementing QBMPS, aligning with previous research. Mastitis emerged as a major cause of milk rejection, underscoring the importance of proper milking techniques and animal health management. Farmers employed strategies to minimize financial losses from rejected milk, such as feeding it to animals or selling it separately.

5.5 Effects of adopting QBMPS on farmers and cooperative

5.5.1 Effect on farmers

The interviews with key stakeholders emphasized the positive impact of a QBMPS on farmers' income. Punyapornwithaya et al. (2022) carried out a study to compere the quantity of farmers in terms of benefit they got from adopting QBMPS in Thailand. The report provided more evidence for the advantages of a payment program based on milk quality, showing that a significant portion (70%) of dairy farmers benefited from the program in terms of better milk quality and income. The system has both socioeconomic and technical impacts, as the system motivates the farmers to work better and therefore the quality of the milk supplied improves (Meneghatti et al. 2020).

Ndambi et al., (2018) highlighted, in their study that piloted QBMPS with the Happy Cow, the substantial expenses and possible social gains associated with enhancing milk quality and safety. A higher standard of milk could reduce the financial strain of medical expenses incurred in treating milk-related disorders. And also increase the fat and SNF content, discourage the adulteration and encourage farmers to adopt better farming techniques. Another study focused on the cost and benefit of QBMPS in Kenya, it was stated that farmers capable of supplying grade A milk gained a net profit estimated at 2.31/kg of KSH. On the other hand, those supplying grade C milk experienced a net loss because of the rejection of their milk (Ndambi et al. 2018).

However, stakeholders also brought to light challenges related to the implementation, including costs, resistance, and traceability issues, particularly within smallholder systems. This was revealed by other studies which reported that quality assurance of food systems in Kenya especially the dairy sector is complicated by the dominance of smallholder farmers in the sector and by a growing number of processors who compete for milk volume (Ortega & Tschirley, 2017). Poor milk quality has a negative effect on the profit margins and market access of privet businesses due to its impact on product yields, taste, and extended shelf life of the product (Ndambi et al. 2018).

Furthermore, the focus group discussions provided a platform for farmers to express their perspectives on the QBMPS. Divided into two groups, the farmers engaged in a comparative analysis of the benefits and costs of the QBMPS in comparison to the existing volume-based payment system. This approach allowed for a detailed exploration of the advantages and potential drawbacks of transitioning to a quality-based payment system.

The incorporation of a ranking form in the discussion was instrumental in gauging farmers' perceptions regarding the impact of the QBMPS on their income and evaluating the associated costs and benefits. The findings highlighted distinct differences between the two farmer groups, particularly in their prioritization of aspects such as an increase in milk price and market access. Notably, both groups expressed skepticism regarding the fairness of compensation within the proposed quality-based payment system, showcasing a prevailing concern about whether the system would adequately reward their efforts.

This discrepancy in perceived fairness may stem from apprehensions and uncertainties surrounding the practicality and viability of the quality-based payment system. Addressing these concerns and ensuring a transparent and equitable compensation mechanism is crucial to fostering farmer trust and acceptance of the QBMPS. Effective communication, educational campaigns, and supportive policies are essential in bridging the understanding gap and building confidence among farmers regarding the proposed payment system. A study investigated compliance with food safety measures in milk production in Nepal and found that factors such as access to information and perception of food safety assistance influenced the adoption of these measures (Kumar et al., 2016).

The research collectively highlights the potential benefits of implementing a Quality-Based Milk Payment System (QBMPS) for dairy farmers. Studies emphasize its positive impact on milk quality, farmer income, and livelihoods. However, challenges like implementation costs, resistance, and concerns about fairness and practicality need to be addressed. Transparency, equitable compensation, and educational initiatives are essential for successful QBMPS integration. Accessible information and a focus on food safety perceptions also play significant roles in encouraging the adoption of quality measures. In summary, QBMPS offers a promising path for improving the dairy industry's sustainability and farmers' well-being, with necessary considerations for effective implementation.

5.5.2 Effect on Cooperative

The interview with graders and quality assurance personnel emphasized several significant challenges in implementing the QBMPS. These challenges primarily revolved around the quantity of milk supplied by farmers, the costs associated with testing, and the need to hire extra staff. These challenges pose operational and financial hurdles that need to be addressed for the successful implementation of a quality-based payment system. Moreover, the low volume of milk supplied by small-scale farmers was highlighted as a concern, as the farmers often provide less quantity and conducting tests separately for such quantities might be costly. Finding cost-effective solutions is essential when working with smaller quantities of milk because the cost of each test tends to increase. In this case, it is crucial to ensure the quality of all milk, regardless of quantity, but evaluating lesser quantities would be prohibitively expensive.

KALRO, an agricultural research organization, stressed the importance of improving milk quality through various means, including the development of diverse fodder and forage species. The feeding practices of dairy livestock and rearing system directly impacts milk productivity and quality by either reducing or enhancing fat and protein content in milk, as well as the physiological and microbiological processes in cows (Alothman et al., 2019., Mollica et al., 2021., Sufyanova et al., 2023). Moreover, the KII from KALRO pointed out that the main challenge in Githunguri is land shortage, adversely affecting feed production, and herd size, and forcing farmers to purchase feed from other counties. The proposed solutions include introducing diversified feed sources to enhance both volume and productivity, involving cooperatives in fodder production, and advocating for a distinct value chain for quality-based milk payment.

A noteworthy suggestion from a policy and market specialist for improving milk quality and livelihoods is marketing premium milk, which entails establishing a separate value chain with dedicated actors and premium incentives. Government participation in extension services, antibiotic utilization control, and collaboration with national dairy organizations was also emphasized. Additionally, the text highlights the role of large-scale farmers as initial participants in quality-based payment systems due to their resource advantage, foreseeing positive spillover effects on cooperatives and value-added product outcomes.

A Quality-Based Milk Payment System (QBMPS) offers numerous benefits, notably enhancing milk quality and safety. By incentivizing farmers to produce higher quality milk, the QBMPS improves overall milk standards and safety, positively impacting public health. Incentives through this system encourage farmers to monitor and enhance their practices, leading to better compensation and improved livelihoods. Moreover, marketing premium milk through a separate value chain elevates the status of milk as a high-quality product, resulting in increased profits and enhanced livelihoods for farmers. Collaborative efforts with government agencies and national dairy organizations reinforce the adoption of QBMPS, promoting a safe and standardized dairy industry, and government policies play a crucial role in fostering a conducive environment for widespread adoption.

In contrast, the system involves considerable financial costs. Primarily, the expenses stem from testing, encompassing specialized equipment, chemicals, and skilled labour for comprehensive milk quality assessments, adhering to regulatory requirements. Resistance from stakeholders, particularly farmers and processors, poses another challenge, as changes to established payment systems may be met with apprehension and resistance. Additionally, the implementation of accurate traceability, especially within smallholder systems, is difficult due to fragmentation, necessitating investments in technology and processes.

5.6 Readiness Level of GDFCS for Adopting QBMPS

The study illuminates a comprehensive assessment of a cooperative's readiness to implement a Quality-Based Milk Payment System (QBMPS) using a readiness level ranking matrix. The matrix, employing a scoring range of 0 to 5, effectively evaluated the cooperative's preparedness across critical criteria such as availability of milk test and quality standards, previous quality records, the status of the cold chain, farmer's awareness and willingness, as well as the cost and benefit analysis associated with QBMPS.

5.6.1 Level 1: Milk Content (Fat & Protein)

In regard to milk composition encompassing fat and protein, the cooperative received a high readiness rating of (5). GDFCS demonstrates the capability to conduct a range of milk quality tests, either individually or post bulking, and exhibits a strong commitment to maintaining detailed quality records. This indicates a significant capacity and well-established infrastructure within the cooperative to effectively execute a quality-based milk payment system. The presence of accurate milk tests and comprehensive quality documentation lays a robust foundation, ensuring the consistent and dependable quality of dairy products. It substantiates the cooperative's ability to adhere to the Quality-Based Milk Payment System (QBMPS).

5.6.2 Level 2: Product Quality (SCC, TBC, Antibiotic residue, Aflatoxin and Adulteration)

The Githunguri Dairy Farmers Cooperative Society (GDFCS) achieved a high rating of 5 in their capacity to test various parameters and adhere to KDB standards. The cooperative has implemented penalties for instances where the quality parameters are not met. For instance, if a farmer is found to have adulterated their milk, it is rejected and the farmer is fined 50% of their total milk supply for that month. In the case of repeated adulteration offenses in the third time, the member risks losing their membership. The penalties imposed for adulteration serve as a deterrent, emphasizing the importance of maintaining milk purity.

Similarly, for elevated Somatic Cell Count (SCC), aflatoxin and antibiotic residue in the milk, the grader promptly reports the issue through an online platform. Subsequently, the responsible extension officer is notified to visit the farm and conduct rapid tests. The immediate reporting and subsequent action taken for elevated Somatic Cell Count (SCC) and antibiotic residue underline the cooperative's commitment to milk safety and prompt response to potential quality issues. This approach aligns with industry best practices and is vital for ensuring consumer satisfaction and maintaining a strong reputation in the dairy sector. Further research and ongoing monitoring could provide insights into the long-term effectiveness and impact of these measures on the cooperative and the wider dairy industry.

5.6.3 Level 3: Cold Chain (Cooling tank, distance and frequency)

The condition of the cold chain, categorized as level 3, demonstrated a moderate state of readiness. A moderate level of preparedness (level 3) suggests that there's room for improvement in optimizing the cold chain system. The research pinpointed issues pertaining to the transportation phase, specifically noting the utilization of non-refrigerated vehicles, which could potentially jeopardize milk quality during transportation. This underscores a pivotal area for enhancement to uphold milk integrity and quality throughout the entire transportation process.

The study's findings serve as a valuable indicator, prompting stakeholders to focus on enhancing the cold chain infrastructure, ensuring the availability and utilization of refrigerated vehicles during milk transportation. By doing so, the dairy industry can mitigate risks associated with temperature-sensitive products like milk and improve overall consumer confidence in the product's safety and quality.

5.6.4 level 4 sustainability

In terms of sustainability, the Githunguri Dairy Farmers Cooperative Society (GDFCS) received a sustainability readiness score of 3, influenced by various factors. These factors encompass the farming system, manure management and biogas utilization, rainwater harvesting, and feeding practices. The prevalent intensive farming system in the region primarily arises from land scarcity, indicating a need for sustainable land management practices to maximize productivity. Despite receiving training from the cooperative, a significant number of farmers do not adequately manage manure, adversely affecting milk quality (Verschuur et al. 2021). Encouraging farmers to adopt sustainable farming methods, such as composting and proper manure management, is critical to mitigate its adverse effects.

The predominant forage, Napier grass, poses a challenge as farmers tend to let it overgrow to increase dry matter, inadvertently reducing its quality by diminishing crude protein content. Educating farmers about the optimal growth stage for forage harvesting is essential to maintain both quantity and quality. This education can lead to improved feeding practices and, consequently, higher milk quality. Additionally, the high milk loss rate within the cooperative further hinders sustainability efforts, leading to substantial yearly losses (Katarama., 2022). Employing better milk preservation techniques and streamlining processing procedures can significantly reduce yearly losses, contributing to the cooperative's overall sustainability.

In summary, enhancing sustainability in the Githunguri Dairy Farmers Cooperative Society involves addressing farming practices, forage management, and milk preservation methods. Effective training, implementing sustainable farming techniques, and optimizing forage harvesting are key steps to improve sustainability and foster a more environmentally friendly and economically viable dairy sector.

5.6.5 Level 5: Farmers' Awareness and Willingness

The analysis also shed light on the feasibility of the cost and benefit of QBMPS and farmers' willingness to engage, which were ranked as the second level of readiness, following closely after milk tests and previous quality records. Despite the QBMPS being associated with relatively high costs, it was noted that the substantial benefits, including reduced expenses related to supplement products during yoghurt production and the potential for additional fat extraction from milk, make it a viable and attractive prospect for the cooperative.

Furthermore, the farmer's awareness of the quality system was rated at level 2, indicating a relatively low level of readiness. This lack of awareness among farmers underscores the necessity for targeted educational and informational initiatives to enhance their understanding of the QBMPS and its benefits. Enhancing farmer awareness is pivotal in fostering a cooperative approach and encouraging active participation in the implementation of quality systems.

In summary, while the cost-benefit analysis demonstrates the potential economic advantages of QBMPS, addressing the lack of awareness among farmers is a priority. Educational efforts aimed at increasing awareness can bridge this knowledge gap, empowering farmers to embrace and actively contribute to the successful implementation of QBMPS, ultimately leading to improved milk quality and economic benefits for all stakeholders in the dairy value chain.

5.7 SWOT ANALYSIS:

Based on the results from the survey, interview and focus group discussion SWOT analysis was conducted. The SWOT was related to the levels of readiness (Milk content (Fat & protein), product quality, cold chain and sustainability) of adopting QBMPS. Strengths and weaknesses are internal to the dairy value chain and would be simpler to address, but opportunities and threats are external variables that call for multi-stakeholder engagement.

Strength	Weakness	Opportunity	Threat
Good governance	**Cost to test individually (Fat, Protein, SCC)**	**Ready local market**	**Seasonal chance**
Percentage of Fat & protein (3.5, 3.2) respectively	**Absence of cooling machine in the transportation**	**Presence of supporting policies**	**Diseases (Mastitis)**
Strict quality measures & continuous flow back	**Shortage & Low quality feed**	**Sustainability focus**	**Age of the farmers**
Well organized supply chain (Collection routs, delivering time, good communication signs)	**Land shortage**	**Export market**	**Competitive Landscape**
Dedicated graders for milk grading and reporting to the system	**Poor farm hygiene**	**KALRO providing alternative forage seeds**	**Focus of the market on Volume instead of quality**
Milk quality inspectors for carrying out all the tests and reporting the below the standard	**Popularity of milking by hand, that may reduce the milk quality**		
Extensions officers to train the farmers on quality measure and flow back the member if their milk is rejected.	**Focus of the farmers to deliver high Volume not achieving higher quality parameters**		
Farmers commitments to deliver the milk continuously			

5.8 Reflection of Methodology

Throughout this research endeavour, I have gained a wealth of insights. The field study took place in a location entirely unfamiliar to me, entailing a novel environment encompassing a distinct country, language, culture, and other nuanced disparities. Despite this unfamiliarity, I effectively navigated and engaged with the local community, successfully obtaining crucial information relevant to my study's objectives. However, the research did encounter certain limitations which deserve discussion.

The language barrier was one notable drawback. Many of the farmers surveyed were not proficient in English, preferring to communicate in their native tongue. To preemptively address this, I enlisted the assistance of a translator to facilitate communication when necessary. Nonetheless, the involvement of a translator had its constraints, as their interpretations occasionally exhibited bias, inadvertently influencing responses according to their viewpoints.

The identification of farm owners was another constraint. During farm visits, meeting the actual owners proved to be a tough task, with interactions predominantly involving workers. This situation had a particularly significant influence because the survey's main objective was to determine farmers' perceptions and expectations regarding the system. Due to this difficulty, the survey exceeded the initially projected timeframe.

An additional notable limitation encountered during the research related to the logistical challenge of coordinating interviews with key stakeholders. Given the demanding nature of their schedules, scheduling interviews proved to be a complex undertaking. Regrettably, not all of the initially contacted key informants exhibited a willingness to partake in the research endeavour. Several key stakeholders declined participation, offering apologies and redirecting the inquiry to alternate contacts within their purview.

Moreover, it is noteworthy that certain interview participants expressed a preference for non-recording formats. This preference introduced an additional layer of complexity, as these individuals opted for verbal exchanges that were to be noted manually, rather than captured through audio recording. Consequently, this methodological choice engendered the inadvertent omission of potentially invaluable insights that could have significantly enriched the research outcomes.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

This chapter presents an overview of the research findings, aligning with the objectives of the study. The study aimed to assess the level of readiness of GDFCS to adopt QBMPS and propose possible interventions that can facilitate the adoption of QBMPS and provide a trial implementation plan to the cooperative. The following sections summarize the conclusions and recommendations drawn from the research.

6.1 Conclusions

6.1.1 Current Quality Parameters

The Githunguri Dairy Farmer Cooperative Society (GDFCS) places a strong emphasis on ensuring safe and high-quality dairy products through rigorous quality parameters. Their commitment involves conducting comprehensive tests at various stages of the milk value chain, including collection and cooling centres, with major assessments performed at the processing plant. These tests encompass composition analysis, somatic cell count (SCC), total bacterial count (TBC), and organoleptic evaluations. The cooperative also implements an alcohol test to prevent milk contamination and maintain milk quality. Notably, GDFCS is dedicated to ethical dairy operations, promptly identifying antibiotic residues in milk samples to prevent their entry into the supply chain, in alignment with prescribed thresholds. Overall, their stringent testing practices and dedication to milk quality and safety uphold a solid reputation and instill consumer confidence, aligning with international milk quality indicators.

6.1.2 Drivers of Cooperative to Adopt QBMPS

The Githunguri Dairy Farmers Cooperative Society is driven to implement a quality-based milk payment system, aiming to enhance milk quality, fair compensation to members, and market competitiveness through premium products. This strategic change aligns with consumer demands for higher-quality dairy, encouraging farmers to improve their milk production practices. Additionally, sustainability and member engagement are prioritized to foster transparency, trust, and ongoing progress within the cooperative

6.1.3 Smallholder Farmers' Expectation from Adopting QBMPS

The survey in Githunguri, Kenya, revealed differences in farmers' understanding of the Quality-Based Milk Payment System (QBMPS) between small-scale and large-scale farmers. Large-scale farmers demonstrated a deeper understanding of the system, indicating varying levels of exposure to QBMPS across farmer groups. A farmers' exchange group is essential to enhance knowledge sharing. Despite limited awareness, both groups showed interest in implementing QBMPS, aligning with previous research. Mastitis emerged as a major cause of milk rejection, underscoring the importance of proper milking techniques and animal health management. Farmers employed strategies to minimize financial losses from rejected milk, such as feeding it to animals or selling it separately.

5.6.4 Effect of QBMPS on Farmers and Cooperatives (Cost and Benefit)

5.6.4.1 Effect on Farmer

The research collectively highlights the potential benefits of implementing a Quality-Based Milk Payment System (QBMPS) for dairy farmers. Studies emphasize its positive impact on milk quality, farmer income, and livelihoods. However, challenges like implementation costs, resistance, and concerns about fairness and practicality need to be addressed. Transparency, equitable compensation, and educational initiatives are essential for successful QBMPS integration. Accessible information and a focus on food safety perceptions also play significant roles in encouraging the adoption of quality measures. In summary, QBMPS offers a promising path for improving the dairy industry's sustainability and farmers' well-being, with necessary considerations for effective implementation.

5.6.4.2 Effect on Cooperative

The implementation of a Quality-Based Milk Payment System (QBMPS) has both benefits and challenges. With the implementation of QBMPS, the cooperative gains the ability to diversify its product offerings. This involves leveraging the increased fat content in the milk to create cheese and extract additional cream, expanding their product range and potentially tapping into new market opportunities. Conversely, the system comes with several challenges. These include operational and financial hurdles such as managing the quantity of milk supplied, testing costs, and the need for additional staff. Small-scale farmers contribute less milk, making separate testing cost-prohibitive. Strategies like diversified feed sources, cooperative involvement in fodder production, and distinct value chains for quality-based milk payment are suggested to overcome challenges. Marketing premium milk and government involvement in extension services are highlighted to improve milk quality and livelihoods. While QBMPS enhances milk quality and safety, it involves significant financial costs related to testing and resistance from stakeholders, necessitating technological investments and efficient processes for successful implementation.

5.6.5 Readiness Level

The study thoroughly assessed the Githunguri Dairy Farmers Cooperative Society's readiness to implement a Quality-Based Milk Payment System (QBMPS) using a readiness level ranking matrix. The cooperative exhibited high readiness in critical aspects such as milk composition (fat and protein) and product quality parameters (SCC, TBC, antibiotic residue, aflatoxin, and adulteration). However, there was moderate readiness in the cold chain infrastructure, emphasizing the need for improvements in the transportation phase to uphold milk quality. Sustainability readiness indicated room for enhancement, particularly in farming practices, forage management, and milk preservation techniques. Lastly, farmers' awareness and willingness highlighted the potential economic benefits of QBMPS, underscoring the importance of targeted educational initiatives to enhance farmer understanding and active engagement in the system's implementation for improved milk quality and economic gains.

6.2 Recommendations

This chapter presents crucial suggestions and actions resulting from an in-depth assessment of the cooperative's capacity to put into practice a Quality-Based Milk Payment System (QBMPS). This section offers strategic insights and doable initiatives to improve the cooperative's readiness for QBMPS implementation, building on the findings offered in prior chapters.

Intervention	Activities		Outcome	Impact
1. Enhancing Educational Initiatives	Tailored educational program for the young age to collaborate with educational institutions to promote courses and workshops related to dairy, aimed at engaging young people.	Establish partnerships with governmental and non-governmental organizations Conduct awareness campaigns and workshops, focusing on the benefits of dairy farming and opportunities within the milk value chain.	♦ **Increase youth participation** ♦ **Innovation and Modernization** ♦ **Economic growth** ♦ **Skill Development**	♦ **Well integrated Dairy Value Chain** ♦ **Enhanced Food Security** ♦ **Improved Livelihood**
2. Strengthening Quality Assurance	Enhance the efficiency and accuracy of quality tests, thereby minimizing costs associated with post-bulking tests and ensuring a seamless testing process.	Establish regular training programs for farmers on proper milking techniques, animal health management, and compliance with withdrawal intervals following antibiotic treatments reduce milk rejection rates.	♦ **Improve product Quality** ♦ **Increase Consumer Confidence** ♦ **Market Competitiveness** ♦ **Opportunity to export the products**	♦ **Sustainable Business** ♦ **Reduction of Food Loss**

3. Dairy Sustainable Practices (housing system, feed & fodder, biogas, farm hygiene)	Collaborate with agricultural research organizations, like KALRO to develop sustainable agricultural methods, optimize feed production, and encourage farmers to adopt eco-friendly practices for long-term sustainability.	Introduce incentives for sustainable practices, such as fodder production, waste management, and ethical milking to motivate farmers to implement environmentally conscious strategies in their operations.	♦ **Reduce Carbon Foot Print** ♦ **Water Quality Improvement** ♦ **Waste Reduction & Recycling** ♦ **Community Engagement** ♦ **Market Access** ♦ **Improve Animal Welfare**	♦ **Increase the Resilience of the Dairy Value Chain** ♦ **Positive Environmental Impact** ♦ **Innovation in dairy sector**
4. Bridging Understanding and Adoption Gaps of QBMPS among the farmers.	Organize regular workshops and interactive sessions between small-scale and large-scale farmers to facilitate knowledge exchange and encourage the adoption of best practices, especially in understanding and implementing QBMPS.	Develop informative materials and manuals explaining the QBMPS in a simple and accessible language, ensuring that all farmers comprehend the intricacies and benefits of the new payment system	♦ **Farmers will gain clear understanding of QBMPS** ♦ **Farmers will adopt practice that align to QBMPS** ♦ **Farmers will recognize the economic benefit of QBMPS** ♦ **Farmers will understand the relation between QBMPS and access to premium market**	♦ **Increase consistent of supply of high-quality milk** ♦ **Increase efficiency and reduce the costs**
5. Establish an other extension model, from individual to group approach	Establish a mentorship program within the cooperative, where experienced large-scale farmers guide and support smaller-scale farmers in transitioning to quality-based payment systems and adopting sustainable practices.	Advocate for government support and funding to assist smaller-scale farmers in implementing QBMPS, reducing associated costs, and promoting an inclusive and equitable transition within the cooperative	♦ **Improve farmers' income** ♦ **Enhance status of small-scale farmers** ♦ **Space for knowledge sharing and skill development**	♦ **Increase well-being of small-scale dairy farmers'** ♦ **Increase inclusivity and social equity** ♦ **Increase productivity and quality of the product**

6.3 Intervention

Trial implementation plan:

Objective: A pilot study conducted in Uganda highlighted differing levels of success in the adoption of the Quality-Based Milk Payment System (QBMPS) across small, medium, and large-scale farmers. The implementation of the trial has not been firmly established among small and medium-scale farmers, while large-scale farmers demonstrated successful integration (Ndambi and Daburon., 2019). Therefore, this trial pilot will exclusively be specific for large-scale farmers in Githunguri Society. And the main objective is t try the effective implementation of a quality-based milk payment system in order to encourage milk quality by compensating farmers' efforts.

Duration: 1 year

Participants: Select 50 large-scale members, each owning more than 15 animals. Farmers should be grouped according to their designated routes, prioritizing routes with a higher number of large-scale farmers. This approach aims to optimize resource utilization, such as efficiently collecting milk in designated containers and conducting tests simultaneously for enhanced efficiency.

Implementation steps:

First step: In the initial phase cooperative will select a target using a purposive sampling method and within that group will select 50 members randomly and carry small assessment for the willingness of members to participate. Furthermore, organize orientation week to equip the members with all the required knowledge and collaboratively decide quality standard, and clear payment structure like different milk grades and price that rewards farmers for their quality efforts.

Second step: Analyses the financial part of the project. The cooperative will prepare all the required supplies (test equipment, documents for recording, staff, etc.). provide a better feeding system to increase the quality of the feed and as a result, milk ingredients will be better. Also re-think the breed, for instance currently almost all the farmers rear Friesian for high volume. Therefore, the cross of Friesian with the jersey breed might be a solution for enhancing the volume and quality at the same time.

Third step: Following the completion of the initial and subsequent stages, trial period participants will allocate designated milk containers to farmers delivering milk along the same route. This dedicated set of milk cans will segregate the milk collected from these farmers from the standard milk supply. Post-collection, the milk will be transported to the processing plant for additional quality assessments. To enhance the transparency of the system, farmers will be provided with detailed reports on the quality tests conducted on their milk. When it comes to payment disbursement, each farmer will be compensated fairly based on the determined criteria.

The proposed trial plan for implementing the Quality-Based Milk Payment System (QBMPS) among large-scale farmers in Githunguri-Kenya holds promising benefits for the dairy industry. Firstly, it focuses on enhancing milk quality by incentivizing farmers to improve their practices, including feeding systems and breed selection, leading to a better quality of milk. Secondly, the plan emphasizes efficient resource utilization, such as streamlined milk collection and simultaneous testing, enhancing operational efficiency within the cooperative, potentially resulting in cost savings and smoother processes. Financial viability and sustainability are also key outcomes, with financial analyses and strategic rethinking of farming practices enabling farmers to access premium markets and ensuring the economic viability of the cooperative.

Moreover, the trial encourages active farmer engagement and knowledge sharing, fostering a cooperative approach towards enhancing milk quality. It promotes transparency by providing farmers with detailed quality reports and fair compensation based on clear criteria, fostering trust and confidence within the cooperative. Lastly, the potential for scaling and replication of successful practices to include medium and small-scale farmers indicates a broader positive impact on the dairy sector, providing educational opportunities and setting a model for similar initiatives in other regions.

Milk Quality Parameters and Payment Structure

	Quality Parameters						**Payment Structure**	
	Fat %	**Protein %**	**TBC**	**SCC**	**Antibiotic (-)**	**No Adulteration**	**Payment**	**Amounts**
Grade A^{+}	4	>3,6	< 200,000	<200,000	Negative	Negative	Premium	+2
Grade A	3.5-3.8	3.6-3.3	1-200,000	< 300,000	Max 10 ppb	Negative	Standard	Standard
Grade B	< 3.5-3.25	<3,2	≤ 200,000	>300,000	> 10 ppb	positive	Deduction	-
Grade C	< 3.25	<3	< 200,000	>300,000	> 15 ppb	Positive	Rejection (No Payment)	-

Proposed quality-based milk payment system:

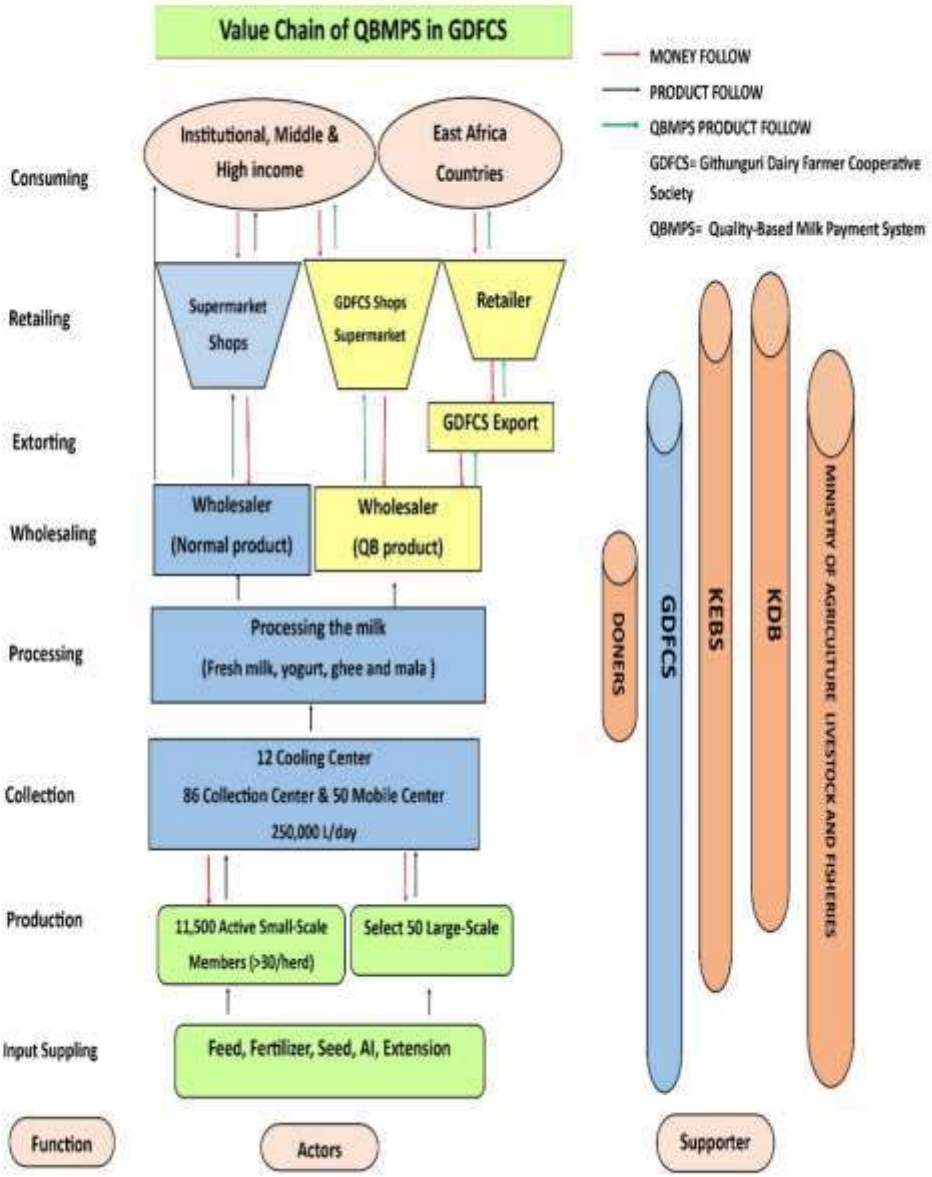

Figure 19 Proposed Value Chain After Adopting QBMPS

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Figure 20 QBMPS Value Chain Map

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Annex

Questionnaire

Questionnaire on assessment of readiness of GDFCS for the adoption of QBMPS in Githunguri Sub-County, Kenya.

I am a master's student in Agricultural Production Chain Management (APCM) - Livestock Chains at Van Hall University of Applied Sciences, the Netherlands. I am currently conducting a survey on readiness of QBMPS assessment in the Milk Value Chain in Githunguri Dairy Farmer Cooperative Society in Githunguri Sub-county. Your participation in this survey would be greatly appreciated, as your responses will contribute to valuable research insights. Please rest assured that your responses will be treated with the utmost confidentiality and will be used solely for research purposes.

Time: 10-15 Minutes

Section A: Respondent Profile

a) Name of respondent: _____

b) Gender
- ♦ Male
- ♦ Female

c) Age
- ♦ Below 30
- ♦ 30-55
- ♦ Over 55

d) Education level
- ♦ Primary School
- ♦ High School
- ♦ University
- ♦ Non

e) Number of Cows (Lactating & Dry): _____

f) Type of breed:
- ♦ Exotic breed (Friesian- Holstein, Ayrshire or Jersey)
- ♦ Indigenous breed
- ♦ Cross breed

Section B: Feed/Breed/Record

1) What type of feed you do feed your animal?
- ♦ Fresh grass
- ♦ Silage
- ♦ Concentrate
- ♦ Hay

2) What type of forage/grass do you feed to your animal?

…….

3) Do you grow your feed or purchase it?

- Grow own feed
- Purchase from others

4) During dry season how do you get feed?

- Use preserved feed
- Purchase from other

5) Do you keep Record in your farm?

a) Yes
b) No

6) What kind of record do you keep?

_____

_____

7) When you are breeding your cow, which category do you select your semen?

a) Production Capacity
b) Fat/Protein Content
c) Cost of the semen
d) Other

Section C: Current Milk Production Practices:

8) What is the duration of……?

- Lactation period …….
- Dry period ……

What is the average of milk production per day per cow (amount/litter) in your farm?

---

8) How much of milk do you…..?

- Use as home consumption/day _____
- Sell to Coop/day: _____

9) Where do you deliver your milk?

- Cooling center
- Collection center

10) How far is the collection/cooling center that your deliver?

- Less than/= 1Km
- 2Km

- More than 2Km

11) What do you use to deliver the milk to the CC?

- Jerry can
- Aluminum Cans
- Stainless steel cans
- Other, please specify; _____

12) Did you faced milk rejection from the GDFCS for the las three months?

a) Yes

b) No

13) If yes, how often do you face milk rejection from the GDFCS for the last three months?

a) Once a week

b) Once within two weeks

c) Once a month

d) Rare

e) Never

14) If you ever faced rejection, what was the main reason?

a) Spoilage

b) Mastitis

c) Antibiotic residue

d) Aflatoxin

e) Other, please specify; _____

15) What do you do the rejected milk?

a) Use as home consumption

b) Sale to others

c) Feed to other animal (Calves, Pigs, Dogs etc.)

d) Other use, please specify ----------

16) Do you know which tests are tested from your milk in Collection/Cooling center?

a) Yes

b) No

17) If yes, please specify which test are in place

---

18) Do you know your production cost per month?

a) Yes

b) No

19) If yes, can you tell us your production cost per month?

_____

20) When the GDFCS normally pays to you?

_____

Section D: Awareness and Knowledge about QBMPS

21) Do you ever heard about quality-based milk payment system?

a) Yes

b) No

22) If yes, how would you describe your understanding of the quality-based milk payment system?

a) Limited

b) Moderate

c) Extensive

23) Have you received any training about quality-based milk payment systems?

a) Yes

b) No

Section E: Perception of Quality-Based Milk Payment System:

24) In your opinion, what are the advantages of a quality-based milk payment system for the farmers?

a) Improves income

b) Incentivizes milk quality production

c) Encourages better animal husbandry practices

d) Other

25) What do you perceive as the potential challenges or disadvantages of adopting a quality-based milk payment system?

a) Setting the coop high quality parameters and inability to meet those standards

b) Lack of knowledge about quality standards

c) Lack of equipment for quality testing

d) Lack of incentives to adopt high quality parameters

e) Other

Section F: Readiness and Adoption:

26) How far are you willing to adopt a quality-based milk payment system?

a) Very willing

b) Slightly willing

c) Not willing

27) How far do you agree with the GDFCS to start adopting quality-based payment system?

- Strongly Disagree
- Disagree
- Agree
- Strongly Agree

28) What factors do you think would facilitate the successful adoption of a quality-based milk payment system?

---

29) What challenges do you foresee in the adoption and implementation of a quality-based milk payment system?

Annex 2: Ranking Form

Effect of Adopting a Quality-Based Milk Payment System on Farmers' Income and Cost-Benefit Analysis

Introduction:

This ranking form aims to assess the effect of adopting a quality-based milk payment system on farmers' income and to evaluate the cost and benefit of implementing such a system. The form will help collect data and opinions from farmers to understand the potential impact and feasibility of the proposed payment system. Please rate each criterion on a scale of 1 to 5, where 1 indicates low impact or feasibility, and 5 indicates high impact or feasibility.

		Score
1.1 Increase in Milk Price:	How much do you expect the quality-based milk payment system to increase the price paid to farmers for higher-quality milk?	1 ○ 2 ○ 3 ○ 4 ○ 5 ○
1.2 Fairness in Compensation:	Do you believe the quality-based payment system will ensure fair compensation for farmers based on the quality of their milk?	1 ○ 2 ○ 3 ○ 4 ○ 5 ○
1.3 Income Growth:	How do you anticipate this system will impact your overall income compared to the current system?	1 ○ 2 ○ 3 ○ 4 ○ 5 ○
1.4 Market Access:	Will the quality-based payment system potentially open up new market opportunities for your milk products?	1 ○ 2 ○ 3 ○ 4 ○ 5 ○
2.1 Initial Implementation Cost:	How do you perceive the cost of implementing the quality-based payment system?	1 ○ 2 ○ 3 ○ 4 ○ 5 ○
2.2 Data Collection and Testing:	Is the process of collecting and testing milk quality practical and efficient?	1 ○ 2 ○ 3 ○ 4 ○ 5 ○
2.3 Quality Improvement Costs:	Do you expect any additional expenses related to improving milk quality to meet the payment system's criteria?	1 ○ 2 ○ 3 ○ 4 ○ 5 ○
2.4 Incentive to Improve Quality:	Will the quality-based payment system provide sufficient motivation for farmers to enhance the quality of their milk?	1 ○ 2 ○ 3 ○ 4 ○ 5 ○
2.5 Sustainability and Long-Term Viability:	How confident are you that the quality-based payment system is sustainable and beneficial in the long run?	1 ○ 2 ○ 3 ○ 4 ○ 5 ○
3.1 Overall Opinion:	What is your overall opinion on the adoption of a quality-based milk payment system?	1 ○ 2 ○ 3 ○ 4 ○ 5 ○

Annex 3: Ranking Form

Drivers of cooperative to Adopt a Quality-Based Milk Payment System

Introduction:

This ranking form aims to assess the drivers of adopting a quality-based milk payment system. The form will help collect data and opinions from cooperative staff/managers to understand the potential impact and feasibility of the proposed payment system. **Please select the most appropriate influence rate for each parameter in terms of adopting the payment system that emphasizes farmers to be paid according to percentage of fat & protein in the milk.**

Parameters	**Ranking**			
	Not influential	**Slightly Influential**	**Moderate Influential**	**Very Influential**
Transparency and Fairness				
Economic Incentives				
Farm sustainability				
Market competitiveness				
Ease of implementation				
Concern for milk quality				

Additional Comments:

Please provide any additional comments or suggestions related to the proposed payment system.

_____
_____
_____
_____

Annex 4: Ranking Form

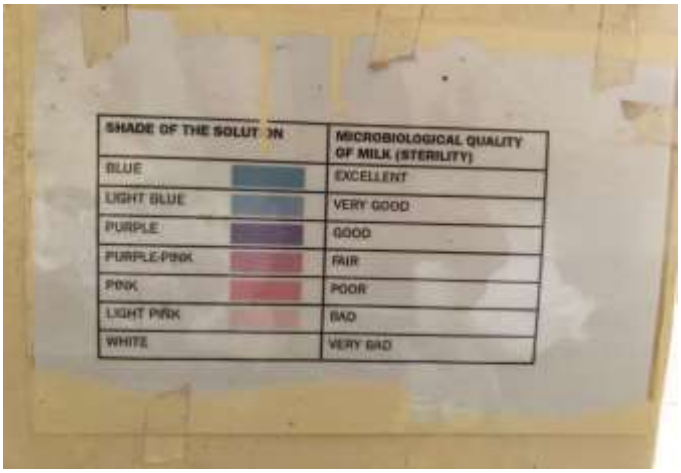
Readiness Level to Adopt a Quality-Based Milk Payment System

Introduction:

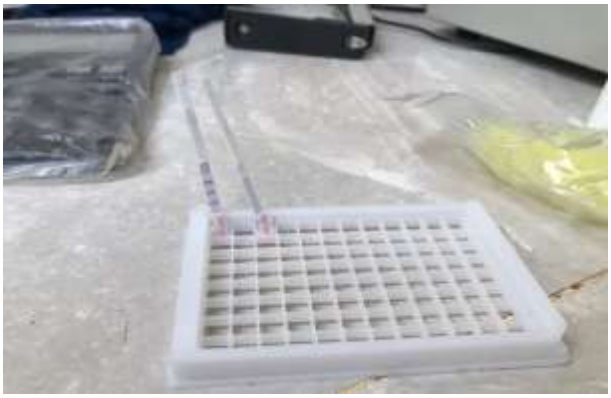
This ranking form aims to assess the readiness level of adopting a quality-based milk payment system. The form will help collect data and opinions from cooperative staff/managers to understand the potential impact and feasibility of the proposed payment system. **Please rate each criterion on a scale of 1 to 5, where 1 indicates low impact or feasibility, and 5 indicates high impact or feasibility.**

	Readiness Level
Milk Tests & quality level	1 ○ 2 ○ 3 ○ 4 ○ 5 ○
Previous Quality Record	1 ○ 2 ○ 3 ○ 4 ○ 5 ○
Cold Chain status	1 ○ 2 ○ 3 ○ 4 ○ 5 ○
Farmers awareness of QBMPS	1 ○ 2 ○ 3 ○ 4 ○ 5 ○
Farmers willingness of QBMPS	1 ○ 2 ○ 3 ○ 4 ○ 5 ○
GDFCS cost to adopt QBMPS	1 ○ 2 ○ 3 ○ 4 ○ 5 ○
GDFCS benefit to adopt QBMPS	1 ○ 2 ○ 3 ○ 4 ○ 5 ○

Annex 5: Some of Milk Quality Tests



SHADE OF THE SOLUTION	MICROBIOLOGICAL QUALITY OF MILK (STERILITY)
BLUE	EXCELLENT
LIGHT BLUE	VERY GOOD
PURPLE	GOOD
PURPLE-PINK	FAIR
PINK	POOR
LIGHT PINK	BAD
WHITE	VERY BAD




Lactoscan
Farm Eco


37.0

Annex 6: Thesis Timeframe

	March				April				May				June				July	August	September	October
Activity	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4				
Initial meeting with Supervisor																				
Reading material on milk quality parameters and payment system																				
Starting defining the research problem, research objectives																				
Pitching Proposal																				
Developing research questions, conceptual framework, and literature review																				
Second meeting with Supervisor																				
Incorporating Supervisor's comments into the research proposal																				
Third Meeting with the supervisor																				
Incorporating Supervisor's comments into the research proposal																				
Submitting the proposal to Moodle																				
Defending the research proposal																				
Field Work																				
Defence & Graduation																				