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Assessment of the Current Status of Milk Production and Farm-level Milk Losses among Smallholder Dairy Farmers in Mogotio Sub-county, Baringo County

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Smallholder dairy farmers account for up to 80% of total dairy producers and 56% of total milk production in Kenya. The reduction of farm level milk losses at the farm level is a critical point in the milk supply chain where improvements can contribute to increased income.
The target population included 840 accessible smallholder dairy farmers and 120 dairy farmers who were purposefully sampled as study respondents during the baseline survey. Thirty farmers were purposefully chosen to participate in focus group discussions. A structured questionnaire, Focus Group Discussion guides, and a Key Informant Interview schedule were used to collect data. Focus Group Discussions and Expert Interviews yielded qualitative data. The data's reliability was then

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estimated using Cronbach's Alpha Coefficient, a measure of internal consistency. Data analysis required the application of both descriptive and inferential statistics. T-tests and the Pearson chi-square test of independence were used for inferential statistics, while measures of central tendency, dispersion and proportions analysis were used for descriptive statistics. According to the findings of the study, the most common milk losses included spillage (30%), excessive consumption by the calves (22%), spoilage (19%) and non-collection of milk due to free-range grazing (17%). Furthermore, most of the farmers (67%) used plastic milk containers. This is worrying because despite a wide variety of plastics existing it is only a few of them that are food grade approved. Microbial contamination through calf suckling is predominant with (71%) practicing free suckling methods which is known to reduce milk yield through milk rejection. The purpose of the study was to assess the current status of milk production and farm-level milk losses among smallholder dairy farmers in Mogotio Sub-county, Baringo County.

Keywords: Innovation; integration; food grade; value addition.

1. INTRODUCTION

Global milk production in 2019 reached 852 million tonnes, an increase of 1.4 percent from 2018, mainly resulting from improved production practices [1]. Domestic animal production has proven to be a good source of food all over the world, and a rapid growth in milk and dairy consumption has been seen in many developing countries. Internationally, around 118 million farms keep dairy cattle [2]. Sixty-five percent of these farms are situated in Sub-Saharan Africa (SSA), South Asia, Eastern Europe and Central Asia.

In Africa, milk output in 2019 is estimated at 48 million tonnes, representing a decline of 1.13% from 48.6 million tonnes produced in 2018 [3]. Over 75% of the milk produce in Africa was cow milk [4]. In Sub-Saharan Africa, nearly 88% of the 31.3 million tonnes of milk produced in 2019 was cow milk, indicating the role of dairy cattle in region. Cattle milk production in the region has been greatly improved by selective breeding, feeding and management practices [5]. Improved milk production significantly contributes to economic growth and employment in the region. Raw milk production is primarily done by smallholder farmers hence it's a major source of employment for the rural population [5]. Therefore, the dairy sector is one of the most important agricultural sectors in Sub-Saharan Africa with a huge potential for alleviation of poverty and improving food security and nutrition. However, role of the sector in rural livelihoods and employment is undermined by several factors, including the adverse effects of climate change. The dairy sector in the region is largely rain-fed hence the industry experiences sharp fluctuation in milk production throughout the year [6].

Major challenge of milk loss at the farm level has not received adequate attention because primary production losses has not received enough attention and rarely improved [7]. There is limited literature in milk losses in Kenya, and available literature has focused on post-harvesting milk losses [8]. Furthermore, milk loses have often been associated to hygiene milking practices has caused microbiological milk spoilage. The study revealed important losses in quality and safety of milk in due to calf suckling. However, losses resulting from suckling prior to milking is increasingly becoming an important point of discussion by stakeholders because it has not received the attention it deserves to help avoid the milk loss [9]. Therefore, addressing milk losses at farm level depends on use of milking practices that not only ensure milk hygiene but also safeguard quantity of milk produced.

The proposed study was carried out in Mogotio Subcounty of Baringo County, Kenya. Dairy farming was one of the major agricultural activities in the county. However, the county only produced enough milk for consumption despite having a favourable climate in some of its high potential areas like Eldama Ravine. As such, the economic potential of the county with regards to milk production had not been harnessed fully. Baringo County is home to the oldest dairy cooperative movements in Kenya since 1960 when cooperative movement started challenging the monopoly of state, the Kenya Co-operative Creameries (KCC). The cooperative movements were launched with aim of increasing the bargaining power of smallholder farmers and increase milk production. Besides, farmers in Baringo County engage in mixed farming and pastoralism in highlands and lowlands respectively, other economic activities include beekeeping, aquaculture and fishing from Lake Baringo. Therefore, rural areas and rural

communities in Baringo were seen as a platform and starting point for economic diversification and innovations for sustainable and resilient development.

Dairy innovation platforms were needed to transform the dairy industry in Baringo, especially Mogotio Sub-county, into innovative, commercially orientated and modern industry that contributed to reduced pre-harvest milk loses and improved incomes to small scale dairy farmers. Thus, this study sought to assess the current status of milk production and farm-level milk losses among smallholder dairy farmers in Mogotio Sub-county, Baringo County, Kenya.

1.1 Statement of the Problem

Milk losses contribute to economic losses resulting in reduced income and living standards among smallholder dairy farmers. Most dairy farmers in Mogotio Sub-County practice inappropriate milking procedures which are tedious and gender insensitive to women who are the main work force in the small scale dairy value chain. This is usually seen in restricted suckling, non-timely weaning and simultaneous milking and suckling. These practices result in milk losses by exposing the 20% cistern milk in the udder to the over age calf. The delayed weaning the calves also contributes to farm level milk losses which translate to reduced income by dairy farmers. Besides significant milk losses, suckling as pre-milking palpation routine is a major impediment to assured milk quality, quantity and safety, which further cause farm-level milk losses contamination and rejection by processors.

2. RESEARCH METHODOLOGY

This chapter explained the procedures utilized in the study. It described the research design, location of the study, population, sample size and sampling procedures. It also presented the data collection instruments, validity and reliability of the instruments, data collection procedures and methods of analysing data.

2.1 Research Design

The study was undertaken on August 2022 in Mogotio sub-county of Baringo county, Kenya. The study employed both Participatory Action Research (PAR) approach and descriptive research survey designs. The descriptive survey involved both quantitative and qualitative approaches to analyse dairy farmer participation in cooperatives in the Mogotio Cooling Centre (MCC). PAR recognizes the changing social, economic, and political environments that shape how technology and innovations are developed and disseminated. PAR offers approaches that engages several actors to create knowledge and actions that empower institutions and communities. PAR involves is fostering collaborations during research process. Thus, PAR is the linchpin in agriculture that connects researchers in several areas of research, ranging from innovations and technology, environmental conservation, livestock, and livelihoods [10,11]. Data analysis required the application of both descriptive and inferential statistics. T-tests and the Pearson chi-square test of independence were used for inferential statistics, while measures of central tendency, dispersion and proportions analysis were used for descriptive statistics.

2.2 Target Population

The target population was smallholder dairy farmers in Mogotio sub-county. The accessible population comprises 840 smallholder dairy farmers supplying milk to Mogotio cooling plant. The study targets a sample population of 120 farmers form the 840 dairy farmers who are constant milk suppliers of the cooling plant. Five cooling plant employees who happened to be dairy farmers and part of the 840 targeted population were targeted. This included the plant manager, accountant, quality control/ milk collection clerk and the two extension personnel. The five livestock production staff in Mogotio sub-county were also targeted.

2.3 Sampling Procedure and Sample Size

Baringo County was selected purposively because it is among counties in Kenya with higher potential for dairy production. Mogotio Sub-county was also purposively selected because of low performance of the dairy sub-sector compared to Koibatek and Eldama Ravine sub-counties. The next step also involved purpose selection of farmers supplying milk to Mogotio dairy farmers cooperative society. Mogotio sub-county had been purposefully identified because of the existence of Mogotio milk cooling plant marketing innovation platform and a large number of smallholder dairy producers. Mogotio ward was selected purposively from the three wards that make up the Sub-county because of its unique features

such as its high milk production levels, diversity of dairy activities, hosting the milk cooling plant and the large scope of small-scale dairy production.

3. RESULTS AND DISCUSSION

3.1 Assessment of Current Status of Milk Production and Farm-level Milk Losses among Smallholder Dairy Farmers in Mogotio Sub-county, Baringo County

Majority of farmers in the region were dependent on pasture only as the main feeding system accounting for 53% of the farmers (Table 1). However, 27% and 20% used zero grazing and combination of pastures and zero grazing respectively. This was highly attributed to the following factors that highly influenced dairy farming in the region; the availability of large tracts of lands that were quite unsuitable for crop production and therefore favoured pastoral raring of dairy cattle, the regions climate that did not highly favour growth of fodder crops and Napier grass that are essential during zero grazing, the breed of dairy cattle that the farmers reared could easily survive on natural pastures as they were hardy and resilient cattle for hot and dry areas, cultural influences that heavily influenced the feeding practices as majority of within the region were majorly as pastoralist community and the high cost of feeds necessary for zero grazing.

However, pastoral feeding system has its own disadvantages over other feeding systems which include: It is challenging for milking cows to consume the substantial amounts of grain required to maintain the high levels of production anticipated due to the high moisture content of pasture, rising temperatures and fly issues, wasted feed from trampling and inconsistent feed quality, as well as variations in quality of feeds and challenges calculating pasture intake. Wilkes *et al.* (2020) discovered dissimilar findings that zero-grazing was the most commonly used feeding system, followed closely by semi-zero grazing and grazing only. According to the research, the most common feeds available for consumption by cattle were natural pasture, Napier grass, maize, commercial and homemade concentrate, and other feed resources such as crop residues and industrial by products. Therefore, there is need for more emphasis on zero grazing for maximum production of milk and also for better planning and feeding practices. Also zero grazing helps the farmer make comparisons on the input levels versus the output levels.

Table 1. Feeding systems used by dairy farmers

Feeding systems	Frequency	Percentage
Zero grazing	29	27
Natural pasture and zero grazing	22	20
Pasture only	57	53
Total	108	100

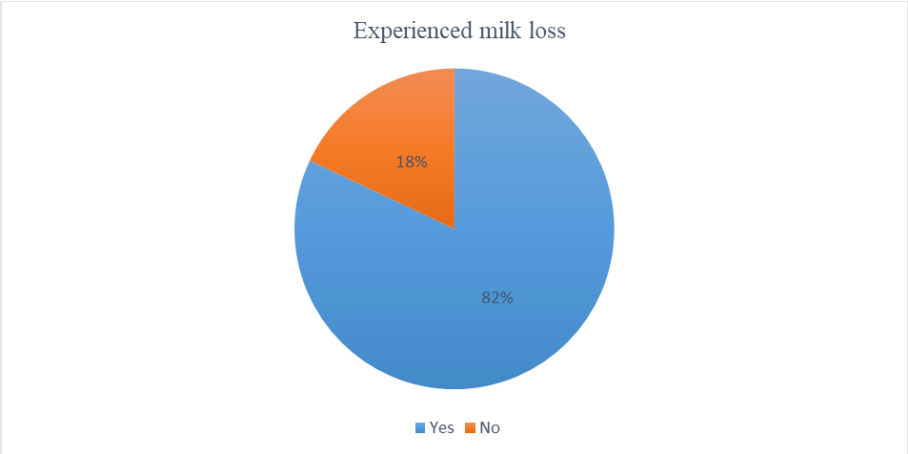

Fig. 1. Experienced milk loss

Table 2. Type of milk losses

Type of milk losses	Frequency	Percentage
Spillage	60	30.3
Excessive consumption by calves	43	21.7
Non-collection of milk	33	16.7
Spoilage	38	19.2
Contamination	20	10.1
Milk thrown away due to diseased cow	4	2.0
Total	198	100

3.2 Farm Level Milk Loses Related Challenges

This section provides results relating to farm level milk losses among the smallholder farmers. Majority of the farmers (82%) had experienced milk losses in their farms.

With regards to the types of milk losses, the most common milk losses included spillage (30%), excessive consumption by the calves (22%), spoilage (19%) and non-collection of milk (17%) as presented in Table 2.

4. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

4.1 Summary

In Mogotio Sub-County, Kenya, With the majority of farmers expressed milk losses due to spillage and excessive consumption by the calves, the innovation platform trained them on early weaning system as an intervention to reduce milk losses. This system allows the calves to suckle their dams for a limited period after milking and the calves also use residual milk in the udder of the cows, which is milk not utilized in the artificial rearing (AR) system. Restricted suckling increases growth rate of the calf, but reduces milk yield and saleable milk of the cow, while reducing the incidence of mastitis and has little or no negative effect on reproduction compared to artificial rearing which most of the farmers in Baringo County were utilizing. The farmers are to be trained on reduction of spillage, contamination and the viability of early weaning which included reduction of labour requirements, capital outlay and calf mortality reduction.

4.2 Conclusions

i). When assessing the current status of milk production and farm-level milk losses among smallholder dairy farmers in Mogotio Sub-county, findings revealed that the majority of farmers were still using outdated dairy farming technology, resulting in massive milk losses. In terms of feeding systems, the majority relied on pasture feeds for their animals rather than other types of feeding systems. It was also revealed that the majority of farmers maintained dairy production records such as livestock registers, dairy milk registers, calving and calf registers. This allowed them to effectively monitor their cattle's progress as well as the milk production processes. Due to the fact that Baringo County is an arid and semi-arid region, the majority of farmers preferred keeping indigenous cattle over exotic cattle because indigenous cattle can tolerate such climatic conditions. Cows and female calves were also kept in comparison to other types of cattle, most likely because these animals provide milk for both households and the market.

The study went on to assess the milking characteristics of the producers, discovering that the majority of these producers did not practice hand washing and used cold water to wash milking containers, resulting in a high rate of milk contamination and spoilage. Nonetheless, milk producers had invested in ensuring that their milking containers were washed with soap and detergents, that they practiced udder cleaning with warm water before milking, and that they had adequate knowledge of milk equipment and manufacturing process handling for the production of safe and healthy milk. Nonetheless, much work remains to be done to reduce the use of plastic containers in milk storage due to the growth of micro-organisms that accelerate the rate of milk spoilage in plastic containers. The majority of dairy farmers had experienced milk losses at the farm level, with the most common being milk spillage during milking, closely followed by excessive consumption by calves and high spoilage rates.

4.3 Recommendation

The following recommendations can be drawn from the study objectives;

i). The majority of farmers had no prior knowledge of milking techniques that could be used to reduce milk losses. However, trainings, through innovation platforms will have a significant increase in knowledge on milking techniques, with the highest impact in increasing milk yields being control of spillage by use of milking parlours, excessive consumption free suckling, non-collection due to free range system, contamination from nonfood grade plastics. Such training is deemed necessary because it enables farmers to learn about new milking techniques that are relevant to improving milk production yields in their cows.

Based on the positive results of this and previous studies, the study recommends that stakeholders in the dairy sector consider widespread implementation of the innovation platform strategy to ensure its uptake.

ii). The study recommends that grassroot collaborative learning take place to sensitize youth on the benefits of the platforms in order to establish opportunities for maintaining an innovation platform-based capacity building program among smallholder dairy farmers. Furthermore, the county governments' and the national government's support must be felt by channeling financial and human resources support to its development and devolution in ward levels.

4.4 Areas for Further Studies

According to the study's findings, innovation platforms have successfully improved milk production yields, household income, and, as a result, livelihoods. However, due to the dynamic nature of the dairying agricultural environment, the innovation platforms are not always capable of adapting sufficiently to emerging trends. This highlights the importance of viewing platforms dynamically and paying closer attention to mechanisms that improve feedback, learning, and capacity building in the innovation processes. As a result, a thorough investigation of innovation platforms and how they can effectively contribute to improving feedback, ensuring collaborative learning, and dynamic management in the dairy industry is required.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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