Review Article

INFLUENCE OF INNOVATION PLATFORM-BASED LEARNING ON FARM- LEVEL MILK LOSSES AMONG SMALLHOLDER DAIRY FARMERS IN MOGOTIO SUB-COUNTY IN BARINGO COUNTY, KENYA

ABSTRACT

Smallholder dairy farmers make up to 80% of total dairy producers and produce 56% of total milk in Kenya. Income from milk is the main source of their annual recurrent revenue. The critical point in the milk supply chain where improvements can contribute to increased income is through the reduction of farm-level milk losses. An innovation platform-based capacity building programme is a programme that brings together all relevant actors to assist in addressing the gaps left by the conventional government extension services when minimising farm level milk loss among smallholder dairy farmers in Mogotio sub-county. This study used a tailor-made capacity building model at Mogotio innovation platform on proper milking techniques that would make milk production economical. The study assessed the current milking practices of suckling, non-weaning and overall milk production during the lactation time through interactive learning sessions in the platform. The study was conducted in Mogotio Ward of Mogotio sub-county in Baringo County, Kenya. The target population consisted of 840 accessible smallholder dairy farmers and a purposive sample of 120 dairy farmers were involved in the baseline survey. A group of 30 farmers was selected to participate in focus group discussions. Farmers were selected for the end of project survey to determine the influence of the innovation-based capacity building programme. The interactive learning in the study assisted in broadening the knowledge base of farmers leading to improved milking techniques, high yields, more income, improved food security and hence improved livelihoods. The results from this study helped in enhancing capacity of smallholder dairy farmers and may inform policy in the dairy sector.

Key words: Integration, innovation-capacity, food security, farm-level milk losses

INTRODUCTION

The global dairy industry is spread out in many countries with unique production practices and consumer markets. It is growing fast and the global milk production is projected to increase by 177 million tons by 2025 (**FAO, 2021b**). The rising population, urbanization and increase in income in developing markets are some of the factors responsible for the increasing demand for dairy product. The industry has a wide range of products including cheese, milk, cream, butter, curd, and kefir. However, milk is the main dairy commodity worldwide (**Eskola *et al.*, 2020**). Some of the common animals in the dairy industry include; cows, goats, camels, and buffalos, where cows lead in milk production globally. According to **Opoola *et al.* (2019**), Eastern Africa countries, namely Ethiopia, Kenya, Uganda, and Tanzania, account for the largest share of cow milk produced in sub-Saharan Africa, with Kenya being the leading producer in the sub-region. Recent statistics by **FAO (2021a)** revealed that Eastern Africa countries contributed about 63% of the cow milk produced in

sub-Saharan Africa. According to the estimates, 22 million tonnes of milk were produced in the sub-region in 2019 suggesting a remarkable performance by the industry. However, despite taking the lead in milk production in sub-Saharan Africa, Eastern Africa countries' produce a paltry 3.5% of the global milk output despite accounting for approximately 21% milking cows in the world **(FAO, 2020; Wilkes *et al.*, 2020**). A major challenge for the Kenyan dairy sector is the near stagnation in milk production. In 2016, Kenya had about 6.5 million dairy cows, which dropped significantly to 4.61 million in 2019. The decline in heads of dairy cows culminated into a drop of milk production from 4.1 million tonnes in 2016 to 3.98 million tonnes in 2019 (**FAO, 2021)**. Nonetheless, there was a marginal increase in cow productivity, with milk yields in 2016 and 2019 being 0.63 and 0.86 tonnes, respectively. However, this is far below the global average of 2.2 tonnes per cow and the potential, given recent developments in the sector (**Anwar, 2017**). Low milk production in the Kenya has been attributed to decrease in land sizes, poor animal husbandry, and high cost of food input, poor quality feeds and adverse effects of climate change (**Bingi *et al.*, 2015**). Other challenges facing the dairy industry are problems related to policy and industry regulations, low producer prices that deter investment in milk production, milk losses from farm-level to market and processing, and high cost of production. Mogotio sub-county of Baringo County covers an area of 1303.87 km^2 with three wards namely; Mogotio, Emining, Kisanana situated south of Baringo county. The sub-county is home to Tugen sub-tribe of the Kalenjin tribe. The sub-tribe are primarily livestock keepers. Mogotio sub-county in Baringo County hosts one of the oldest dairy cooperatives namely; Mogotio Farmers' Cooperative Society, which commenced its operation in 1963. The cooperative has of over 2500 members compared to cooperatives in high potential sub-counties such as Sabatia Farmers' Cooperative with 1500 members (**Chebet, 2020**). In terms of capacity, Mogotio Farmers' Cooperative Society receives about 7,000 litres of milk daily from active farmers compared to 3,000 litres for Sabatia (**Chebet, 2020**). Despite high milk volumes received by the Farmers' Cooperative, its dairy product portfolio is less diverse compared to other cooperative societies due to low milk cooling capacity. At the same time, more dairy farmers in Mogotio than in Koibatek and Eldama Ravine still practice open field grazing and use the calves to stimulate milk let down before milking resulting in milk losses. Calves are allowed to suckle and then tethered next to the cow to stimulate milk let-down. After milking the calf is allowed to suckle the dam for a limited period. Dairy innovation platforms were needed to transform the dairy industry in Baringo County, 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 determine the influence of the innovation platform in reduction of pre-harvest milk losses among smallholder livestock farmers in Mogotio sub-County in Baringo County. Livelihood-secure households are food secure when they are able to acquire, protect, develop, utilize, exchange and benefit from assets and resources. In addition, a combination of understanding of socio-environmental context and agricultural technology yields more income, improved food security and improved access to and use of other assets (**Shiferaw *et al.*, 2014).** Thus, strengthening of the understanding socio-environmental context creates a virtuous circle for further strengthening of livelihoods. 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 dead age calf. The delayed weaning of calves also contributes to farm-level milk losses which translate to reduced income for dairy farmers. Besides significant milk losses as well as suckling as pre-milking palpation routine is a major impediment to assured milk quality, quantity and safety, which further cause post-harvest milk losses contamination and rejection by processors. Nonetheless, there is scarce literature focusing on farm-level milk losses resulting from use of inappropriate milking techniques in Baringo County and in Kenya. Studies mostly focus on post-harvest losses and implications on household welfare indicators such as incomes and food security, ignoring the importance of social and economic losses associated with pre-milking and milking practices. Therefore, the innovation platform strategy created a forum in which smallholder farmers learned and received new knowledge through training and sharing technical information on the reduction of milk losses. This had not been implemented in Mogotio sub-county, which is one of the leading milk producing sub-counties in Baringo County. Therefore, this study utilized the existing Mogotio production and marketing innovation platform and structures to integrate participatory capacity building of farmers in the Mogotio sub-County in order to contribute to reduction of social and economic losses associated with inappropriate milking practices. The purpose of the study was to determine the influence of innovation-based capacity building in sharing knowledge on reduction of farm level milk losses among smallholder dairy farmers. The objectives of the study were to assess the current status of milk production and farm-level milk losses among smallholder dairy farmers in Mogotio sub-county in Baringo County.

Global milk production in 2019 reached 852 million tonnes, an increase of 1.4 percent from 2018, mainly resulting from increases due to improved post-harvest practices but milk losses still posing a major challenge to increased income for dairy farmers globally (**Eskola *et al.*, 2020).** Dairy market review shows that 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 (**Spielman *et al.*, 2019**). Sixty-five percent of these farms are situated in sub-Saharan Africa (SSA), South Asia, Eastern Europe and Central Asia (**Nyokabi *et al.*, 2021**) most of whom are smallholder dairy farmers facing a myriad of challenges mostly to do with the management of their enterprises. Multi-stakeholder alliances or platforms are an increasingly popular approach to enhance collaboration and innovation within the agricultural research for development sector (**Dror *et al*., 2016**). The fact that previously disconnected stakeholder groups come together to diagnose agricultural and broader livelihood problems, identify opportunities and find ways to achieve their goals is among the main benefits of innovation platforms (**Klerkx *et al.*, 2012**).

METHODOLOGY

The study employed both Participatory Action Research (PAR) approach and survey designs. PAR recognizes the changing social, economic, and political environments that shape how technology and innovations are developed and disseminated. The PAR offers approaches that engage several actors to create knowledge and actions that empower institutions and communities. It involves fostering collaborations during the research process. Thus, PAR is the linchpin in agriculture that connects researchers in several areas of research, ranging from innovations and technology to environmental conservation, livestock, and livelihoods (**Méndez *et al.*, 2016; 2017)**. Furthermore, PAR is a process that entails collaborative identification of challenges facing rural farming societies, implementation of solutions to the problems, and tracking the impacts of the implemented solutions (**Shames *et al.*, 2013**). Research, non-research, and other relevant partners are involved in fair and equitable participation in reflection and action such as applying agricultural practices, community development or social change process **(Bacon *et al.*, 2005).** To achieve its purpose, PAR involves identification of stakeholders, conversations about common activities, consolidation and validation of multistakeholder feedback, and taking action.

Theoretical Framework

The study used Lewins Theory of Change. The model focuses on behavior. Kurt Lewin theorized a three-stage model of change that has come to be known as the unfreezing-change-refreeze model which requires prior learning to be rejected and replaced, (**Kurt, 1958).** The model distinguishes three stages; the unfreeze stage which prepares people and organizations for a desired change. The change stage is where the desired change is implemented and the last stage which is the refreezing stage is where the desired change is solidified so that people do not revert to their old habits of doing things. The model can be used to explain the process of introduction, implementation and stable adoption of individual and organizational behaviour related to new technologies or institutional development innovations. Smallholder farmer groups have to make behaviour changes as may be influenced by institutional strengthening processes (**Sarayreh *et al*., 2013).**

Conceptual Framework

The conceptual framework developed will be one that puts into consideration systems and their interaction in an effort to reduce farm-level milk losses. The interaction between research, extension service providers and the milk cooling plant platform will be assessed to allow use of already existing education modules on proper dairy production modules for training. This will be aimed at reducing the farm level milk losses emanating from the poor farming practices. The conceptual framework will take into consideration the continuous interaction between actors in the system which are all mutually benefitting in the engagement as presented in Figure (1).

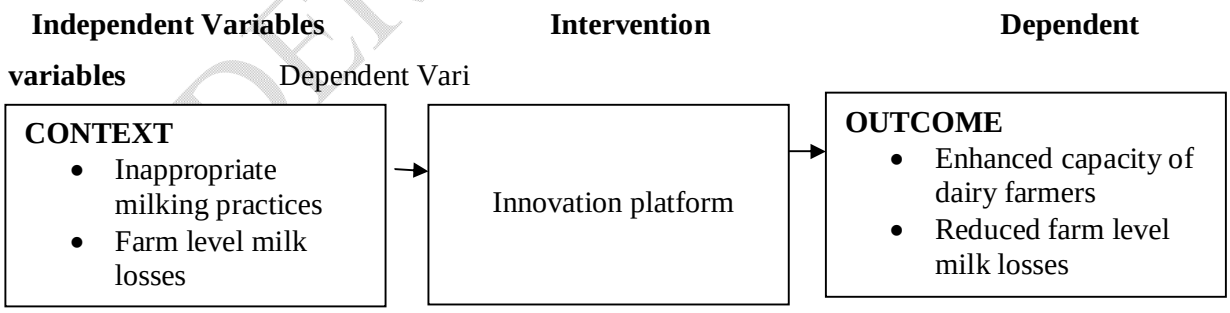

Figure 1. Conceptual framework showing interactions and intervention towards reduction in farm level milk losses

The common problem identified as milk losses will need a common concerted effort by all stakeholders thus calling for clear road map in achieving the goal.The conceptual framework puts into consideration systems and their interaction in an effort to reduce farm level milk losses. The vulnerability context which mainly involves inadequate knowledge on improved

milking strategies and weak linkages on dairy advisory will need a robust capacity building innovation platform. This will be able to produce desired outcomes of improved interaction, enhanced interaction, collective social learning and eventually reduction in farm level milk losses. This interaction is continuous in a cyclic and systemic nature. The study will measure the influence by analysing the specific number of those who have been gone through capacity building and the amount of increase in milk production emanating from reduced milk losses. The variables will be those that facilitate specific tailor made training units on proper milking practices, an intervening proper functioning innovation platform and an outcome which will be reduction in farm level milk losses. The main variables will address weak linkages on dairy advisory services through the use of Mogotio cooling plant innovation platform and enhance knowledge by training actors.

Sampling Procedure and Sample Size

Baringo County was selected purposively because it is among counties in Kenya with high dairy production potential. 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 farmer's 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. Random sampling was then applied to select farmers to participate in the study to ensure that each farmer had equal chance of participating. A list of farmers obtained from the Mogotio dairy farmers cooperative society constituted the sampling frame, meaning that the target population was finite. Therefore, Probability proportional to size (PPS) was used to determine the sample. The formula derived from **Skinner, (2014)** was as following:

Prob 1= (a x d) ÷ b (a= Cluster population, b= Total Population,d= Number of Clusters),

Prob 2= c / a (a= Cluster population c= Number of individuals to be sampled in each cluster).

Applying PPS?? formula based on the researcher's conversation with Mogotio dairy farmers cooperative society management resulted in 120 out of 840 farmers. This was scientifically sufficient to yield result that were acceptable and this was distributed into 40 dairy farmers per ward thus was being proportional to its size in the entire population. Then, systematic random sampling was used to select farmers in each Ward or village. The Key informants

included extension, county government and dairy cooperative staff plus processors. Three dairy farmer FGDs ?? in each Ward were conducted, where both men and women participated. The number of participants per FGD ranged between 6 to 12. To establish the total number of the respondents who actively participated in the study by answering and submitting the questionnaires for data analysis, an analysis of the response rate was carried out. The total response rate comprised 108 respondents, which is 90% of the total sample size.

Both descriptive and inferential statistics were generated using the Statistical Package for Social Science (SPSS) version 26.

RESULTS

The response rate of 90% gave the study a high degree of representativeness that could be relied upon to generalize the respondents' views. The study findings revealed that 48 respondents (44.3%) were in the range of 51-60 years, followed by 25 respondents (22.8%) aged between 41-50 years and those aged between 31-40 years were 18 (16.5%).Fifty-three of the respondents (49.4%) confirmed that free suckling was low while 23 (21.5%) confirmed that it was high. However, 19 (17.7%) and 8 (7.6%) of the respondents supported that free suckling milking system were moderate and very high respectively. Only four respondents (3.8%) reported that restricted suckling milking system was low. Majority 71 (65.8%) of the respondents agreed that post suckling milking system was moderate while 18 (16.5%) agreed that it was high Majority of the respondents 89 (82.3%) agreed that non-suckling milking system was very high while 11(10.1%) of the respondents agreed that non-suckling milking system was high. Generally, most of the respondents 100(92.4%) of the respondents agreed that non-suckling milking system was high.

DISCUSSION AND CONCLUSION

Response from farmer's interviews indicated that there are specific interventions in addressing the issues of low milk production. This implied that despite farmers engaging in farming there are issues that face farmers resulting to low milk production. The farmer emphasized on one of the issues that affect dairy farmers within the regions. The current interventions to address low milk production among smallholder dairy farmers include feeding, pasture establishment and feed storage, disease control and breeding. From the interviews one farmer emphasized on pasture establishment and feed storage. Well established and well-planned feed storage ensures availability of animal feeds during drought season, pasture mixtures provide the best intake for dairy cows increasing milk production. Responses by farmers from focused group discussions revealed that there are strategies that

can be taken to increase participation of youths and women in decision making on how to reduce farm milk losses. This implied that women and youth can provide the best solutions to reduce milk loss levels. Women and young youth should be given an opportunity to be responsible in innovations platforms in the agriculture sector. The best way to involve this young woman is by reducing the cost of production so as to increase profit of agricultural enterprises. One of the participants from the focus group revealed that if women and youths will be given an opportunity to work in agricultural sectors other youths will be motivated to follow the same example. Responses of farmers from the focused group discussion revealed that there are major challenges that and opportunities in maintaining innovation platform. The participants in this focus groups noted that one of the challenges is low network coverage in some areas of the sub-county. Low network coverage has contributed to lack of information, security concerns and high adaption costs.

RECOMMENDATIONS

Farmers who participated in the discussion reported that long distance between the wards in the sub-county is also a challenge. One of the opportunities revealed by the participants is that increased number of youths in innovation platform due to the use of digital information technology and social media. Increased number of youths in innovations increases innovation platforms in terms of employment improves security and generation of income. This helps to drive away poverty through increased productivity and connections to other sectors. Devolution of innovation to ward levels will help to promote a conducive environment for problem solving at different levels.

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