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**Research Article**

# EFFECT OF ON-FARM FEED ESTABLISHMENT, CONSERVATION AND FORMULATIONS INNOVATION PLATFORMS ON MILK PRODUCTIVITY

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**Abstract**

Cultivated forages play a major role in the diets of smallholder dairy producers' animals as well as the survival of their farm businesses. These forages, which include a range of grasses and legumes, are vital for dairy cattle productivity and income for smallholder dairy farmers. Efforts to promote feed establishment, conservation and formulation have been geared towards the use of innovation platforms. However, there is limited empirical evidence on effect on-farm innovation platform trainings on smallholder farmers' milk productivity. This paper sought to fill this knowledge gap by examining the effect of on-farm feed establishment, conservation and formulations innovation platforms on milk productivity of smallholder dairy farmers in Kenya. An action-based research and cross-sectional survey was conducted in two wards (Ololmasani and Kapsasian) in Kenya and the data was collected from a total of 100 smallholder dairy farmers (50 of the participants who were trained on feed establishment, conservation and formulation). Quantitative data was analyzed using descriptive statistics, chi-square, and regression analysis. The results showed that majority of the respondents (72%) did not store any forage in their farm. For those who stored, the most common forage stored were hay (10%), silage (8%) and both at 10%. Concerning the factors that influence the probability to be the included in innovation platform training, the logit regression results indicated that education level of household head (z= 3.73), land size under dairy farming (z= 2.39), experienced shortage of feeds (z=2.71) and trained on silage making (z=2.3) had a positive effect. While, work of household head (z=-1.97) and distance to nearest output market (z=-1.9) had negative and significant effect. Smallholder farmers who participated in the innovation platform training had higher milk productivity of 14.10 liters, compared to 9.72 liters of non-participants. The regression analysis indicates that participation in innovation platform training increases milk productivity by 4.38 units. This study confirms that training under innovation platform plays great role to bring change in dairy technology adoption which further enhance milk productivity and smallholder farmers' income.

**Keywords:** Innovation platform, Feed conservation, Feed establishment, Feed conservation, Milk productivity.

## INTRODUCTION

The global demand for high-quality milk, driven by an increasing population is currently putting great pressure to smallholder farmers to intensify their dairy enterprises (FAO, 2021). Steady supply of quality feed and fodder assures productivity enhancement among smallholder agrienterprises. This is given by the backdrop that Feeding constitutes about 60–70% of total cost of milk production in dairying (Nimbalkar *et al.*, 2022). Feeds accounts for 60-70% of the cost of production in dairy, implying that supplying adequate quantity and quality feeds is a requirement to addressing production limitation in dairy production (Njarui *et al.,* 2021). According to Schönleben *et al.* (2020), nutrient efficiency and animal performance are strongly affected by four factors: feed quality and quantity, ration formulation, ration delivery and supply. Enhancing feed formulation and sustainable farming practices is crucial for ensuring food security and economic growth amidst a changing world (Akintan *et al.,* 2024). Cultivated forages play a major role in the diets of smallholder dairy producers' animals as well as the survival of their businesses (Dey *et al.,* 2022; Dut, 2023; Lemaire *et al.,* 2019). These forages, which include a range of grasses and legumes, are vital for dairy cattle productivity and general health because they include vital elements like fiber and protein. Chepkoech *et al.* (2021) use of fodder in feeing dairy animals is economically feasible since it minimizes smallholder farmers' production cost. This is because it acts basal diet of the dairy cattle and it is able to meet significant feed requirements of the dairy cows (Ashagrie *et al.,* 2023). Given that forage/fodder is the primary component of all ruminant diets, its quality is critical to animal production (Aranguiz & Ur, 2019). Home grown and conserved fodder, are affordable, reliable and an effective strategy to boost milk production for smallholders because they would minimize market risks arising from price fluctuations (Chepkoech *et al.,* 2021). Use of farmed forages by smallholder dairy producers is severely threatened by the effects of climate change. Unpredictable fodder availability and quality can result from unexpected extreme weather events, extended droughts, or erratic rainfall, among other weather pattern fluctuations (Smith *et al.,* 2019). These disturbances impair farmers' capacity to efficiently plan and manage their feed resources in addition to affecting the amount and nutritional value of the forages (FAO, 2021). In order to lessen the negative effects of climate change on their farming operations, dairy producers need to embrace adaptation tactics include diversifying their forage species, putting water conservation measures into place, and looking into alternate feed sources (Thornton *et al.,* 2022). Despite the efforts of bringing improved feed production, conservation and utilization technologies and practices to farmers, uptake is still low in East African Countries (Maleko *et al.,* 2018). The contribution of this study is to demonstrate the role of dairy innovation platform on uptake on-farm feed establishment, conservation and formulations. Dairy Innovation Platforms (DIPs) serve as dynamic arenas where various stakeholders within the dairy sector converge with the shared objectives of interaction, learning, and instigating change (Audouin *et al.,*

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2023) These platforms act as catalysts for collaboration, knowledge exchange, and innovation, fostering a vibrant ecosystem of engagement among actors ranging from input suppliers to dairy farmers. Thus, another key contribution of this study is the identification of factors influencing the probability to be the included in innovation platform training on feed establishment, conservation and formulation within a dairy enterprise.

## METHODOLOGY

### Study Area

This study was conducted in Trans-Mara East sub-County, Kenya.It lies within latitude 0° 50′ and 6° 50′ south and longitudes 34° 35′ and 35° 14′ East, with a mean altitude of 1450 m above sea level, and area coverage of 320.5 km$^2$.The sub-county is divided into four administrative units or wards which are Ilkerin, Kapsasian, Mogondo, and Ololmasani (Simotwo *et al.,* 2018). The Sub-County has 22,488 smallholders distributed in each Ward as follows: 6, 297 (Ilkerin); 5, 599 (Kapsasian), 4, 205 (Mogondo), and 6, 387 (Ololmasani) as indicated in Table 3.1 below. The map of the study area is presented in Figure 1. Agriculture is the predominant economic activity of Trans Mara East Sub-County, and smallholder farming provides a living for the vast majority of the population. Mixed crop-livestock farming is the most common agricultural technique, with staple crops like maize, beans, and potatoes grown alongside livestock, notably dairy farming. Smallholder dairy farming provides a key source of income for many households in the sub-county, helping to provide food security and livelihood resilience. The area has a bimodal rainfall pattern, with the long rainy season normally lasting from March to May and the short-wet season lasting from October to December. These rainfall patterns have an impact on agricultural productivity and land use practices in the region, with the majority of farming activities taking place during the rainy season.

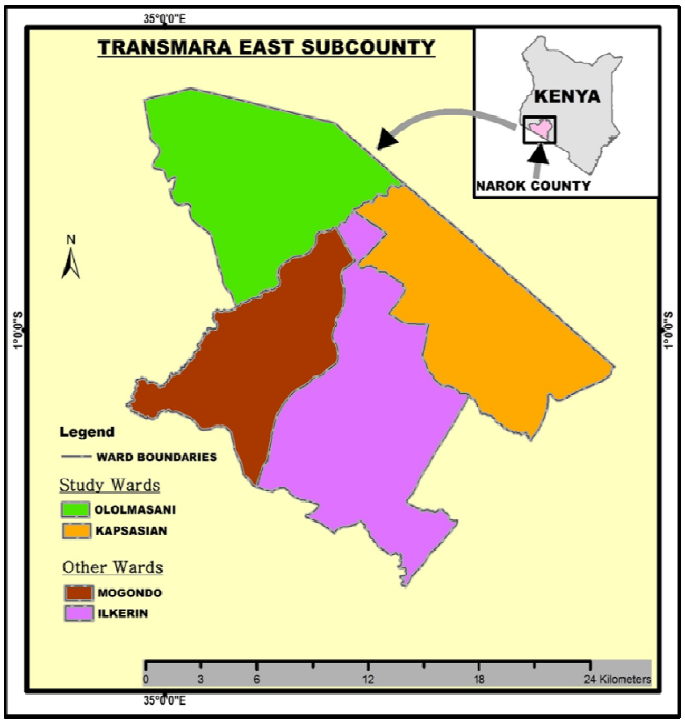


**Figure 1. Map of Study Area**

### Research Design

This study used a mixed research design approach which included descriptive research designs through a participatory action research (PAR).Descriptive research design is useful in the exploration to answer who, what, where and how questions in social science study.The descriptive survey involved the use of quantitative and qualitative data. This design was used to collect data to make inferences about the effect of on-farm feed establishment, conservation and formulations innovation platforms on milk productivity among smallholder farmers in Trans Mara East, Narok County, Kenya. While Participatory Action research involves a self-reflective, systematic and critical approach to enquiry by participants who are at the same time members of the research community (Greenwood, 2017).

The aim is to identify problematic situations or issues considered by the participants to be worthy of investigation in order to bring about critically informed changes in practice. Through the participatory action research approach researchers, facilitators and farmers establish an innovation platform. The platform will offer a participatory learning process. Prior to the learning process, a baseline study was conducted to understand the current situation of the smallholder farmers in terms of the following indicators: socio-economic characteristics and institutional characteristics of the farmers, feed resources, feed establishment, conservation and formulation methods used by the farmers. Sequential capacity building sessions on feed establishment, conservation and formulation methods was conducted by the researchers.

### Sampling Procedure

A multi-stage sampling procedure was used to get the respondents of the study. First, Trans Mara East Sub-County, Narok County was purposively selected due to its vibrant dairy sector and dairy farming provides a key source of income for many households in the sub-county. In addition, the sub-county is part of the National Agriculture, Rural Inclusivity Growth project (NARIGP) and the Agriculture Sector Development Support Project (ASDSP 2) who have been implementingthe following interventions to enhance dairy productivity; fodder and pasture establishment, home-made feed formulations, feed conservation and feeding practices.

The second stage of the sampling involved purposive selection of two wards (Ololmasani and Kapsasian) within Trans Mara East Sub-County due to their higher number of smallholder dairy farmers. The total population for these two wards combined was 11,987 people. In the third stage involved selection of respondents in the villages within the wards. The study targeted 50 respondents in each ward whereby 25 smallholder farmers were trained (treated), while 25 were picked using simple random sampling during the survey to act as control group of determining the effect of the innovation platform from each ward to make a total sample size of 100 dairy smallholder farmers.

### Data Collection

Data for this study was collected using a semi-structured questionnaire. The questionnaire contained both open and closed ended questions. The open-ended questions were used to enable the respondents give their opinions or suggestions.

The key sections of the questionnaire were: Section A (socio-economic and institutional characteristics of the respondents), Section B (current farm activities and feed resources), Section C (feed establishment, feed conservation and feed formulation and Section D (livestock inventory and productivity).The questionnaires were administered to the smallholder farmers through a structured interview at their farms. The data collection process took place from December 2023 to February 2024. Since the study was an action research, baseline study was conducted on October 2023 to establish the status of the smallholder farmers in terms of utilization of the feed innovation practices and the challenges they faced in adoption.

This provided a road map in laying intervention strategies that would see improvement in dairy productivity. After the baseline study, a pilot study was conducted in Mogondo ward within Trans Mara East Sub-Countywith 10 households (10% of the calculated sample size of 100) to validate the data collection tools. After the pilot study, on-farm capacity building to the treated groups of smallholder farmers was done for one month on feed conservation, feed formulation and forage establishment. Additionally, the training manuals were developed for the on-farm trainings. At the end of the capacity building programme a cross-sectional study was done to collect information on effect of on-farm feed establishment, conservation and formulations innovation platforms on milk productivity.

### Data Analysis

Quantitative data was analyzed using descriptive statistics, Chi-square, ANOVA and regression analysis. A logistic regression model was used to determine factors that influence the probability to be the included in innovation platform training on feed establishment, conservation and formulation. ANOVA and ordinary least square regression was used to determine the effect of training in feed establishment, conservation and formulation on milk productivity.

## RESULTS AND DISCUSSIONS

### Descriptive Statistics of Respondents

Table 1 presents the descriptive statistics of the households socio-demographic characteristics of the respondents. As shown in Table 1, the majority of the sample smallholder dairy farmers had a mean age of 45 years with a dairy farming experience of 15 years. The total land size under dairy farming was 1.63 acres with a total milk production of 8.21 litres per day. The mean distance to the output market for the smallholder dairy farmers was 14.51 kilometers. With regard to the gender, majority were male headed households (60%), with most working on the farm (73%).

On the other hand, majority of the respondents had reached primary (32%) and secondary (30%) as the highest educational level. Concerning the breed of livestock, they kept, the most common breed was exotic/improved breed (84%). The study also assessed access to different services such as credit, extension and trainings. In relation to access to these services, 71% had access to credit, 72% had access to extension, 22% were trained on hay making and 14% were trained on silage making. Finally, it is evident that most (61%) of the respondents had experienced feed shortage in their dairy farms.

**Table 1. Households socio-demographic characteristics**

| Continuous variables | Mean | Std. dev |
|---|---|---|
| Age of farmers (years) | 45.16 | 1.224 |
| Experience in dairy farming | 15.01 | 0.973 |
| Land size under dairy farming | 1.63 | 1.711 |
| Total milk per day | 8.21 | 0.512 |
| Distance to output market | 14.51 | 0.881 |
| **Categorical variables** | **Frequency** | **Percentage (%)** |
| Gender | | |
| Male | 60 | 60 |
| Female | 40 | 40 |
| Work of household head | | |
| Off-farm | 27 | 27 |
| On-farm | 73 | 73 |
| **Education level of household head** | **Frequency** | **Percentage (%)** |
| Primary level | 32 | 32 |
| Secondary level | 30 | 30 |
| Adult education | 9 | 9 |
| Technical college | 18 | 18 |
| University | 11 | 11 |
| **Livestock breed** | **Frequency** | **Percentage (%)** |
| Indigenous | 16 | 16 |
| Exotic/improved | 84 | 84 |
| **Access to credit** | | |
| Yes | 71 | 71 |
| No | 29 | 29 |
| **Access to extension** | | |
| Yes | 72 | 72 |
| No | 28 | 28 |
| **Experienced feed shortage** | | |
| Yes | 61 | 61 |
| No | 39 | 39 |
| **Trained on hay making** | | |
| Yes | 22 | 22 |
| No | 78 | 78 |
| **Trained on silage making** | | |
| Yes | 14 | 14 |
| No | 86 | 86 |

### Forage conservation and methods

The data presented in Table 2 reveals the responses of smallholder dairy farmers regarding their practices of conserving forage on their farms. Out of 100 respondents, 28% reported that they have indeed conserved forage, while the majority, 72%, indicated that they have not conserved any forage on their farms. For the 72% of the smallholder dairy farmers who reported not conserving forage may often rely on alternative strategies to meet their livestock feed requirements. This could include practices such as rotational grazing, where animals are moved between different pasture areas to optimize forage utilization and regrowth. Additionally, some farmers may purchase supplementary feed such as concentrates or commercially produced forage to compensate for seasonal deficits in on-farm forage availability. While not conserving forage may be a viable option for some farmers, especially those with access to ample grazing land or alternative feed sources, it may pose challenges during periods of forage scarcity or adverse weather conditions. The findings indicated that 28% of respondents reported that they indeed conserved forage on their farms. These farmers could possibly be using various techniques geared towards conservation of the forage on their farms. These could include preserving excess forage during periods of abundance for use during times of scarcity, such as the dry season through making silage, or hay. These conservation practices enable farmers to maintain a consistent and nutritious feed supply for their livestock throughout the year, contributing to improved animal health and productivity. To support the findings, Baltenweck *et al.* (2020) notes that there has been slow adoption of forage feed improvement technologies among Kenyan dairy farmers with majority of

them not even having an idea of what it is. This makes it even harder for them to conserve the forages on their farms. Resource constraints and unlimited knowledge surrounding the forage conservation methods make it even harder for the farmers to conserve the same (Bitew *et al.,* 2021). Boote *et al.* (2022) further notes that adoption of the improved cultivars necessary for forage production has not been successful in the country, making it a fairly common dairy production practice among the farmers especially in SSA.

**Table 2. Forage conservation by smallholder dairy farmers**

| Variables | Frequency | | Percentage (%) |
|---|---|---|---|
| Have you ever conserved any forage in your farm | Yes | 28 | 28.0 |
| | No | 72 | 72.0 |
| | Total | 100 | 100.0 |
| Forms of forage conservation | No | 72 | 72.0 |
| | Hay | 10 | 10.0 |
| | Silage | 8 | 8.0 |
| | Both | 10 | 10.0 |
| | Total | 100 | 100.0 |

Concerning the forms of forage conservation, the findings indicate that among smallholder dairy farmers, hay and silage are the predominant methods for conserving forage, with hay being the most widely used, reported by 10% of respondents, followed by silage at 8%. This suggests that both hay and silage play significant roles in the forage conservation strategies of smallholder dairy farmers. The preference for hay is plausibly attributed to factors such as its simplicity in production and relatively low requirement for specialized equipment, making it accessible to a majority of farmers. On the other hand, silage, despite being less commonly used, offers advantages such as better preservation of nutrients and moisture content, which can be particularly beneficial in regions with unpredictable weather conditions. An additional 10% of the farmers noted that they use both hay and silage in conservation of the forage. The decision to use both hay and silage for forage conservation is justified in the sense that smallholder dairy farmers wish to gain from the maximum benefits of each method while mitigating their respective limitations. By combining both hay and silage in their forage conservation practices, farmers can diversify their feed sources, ensuring a more reliable supply of high-quality feed for their livestock. This approach also provides flexibility, allowing farmers to adapt to changing weather conditions and optimize feed utilization based on the specific needs of their animals. Additionally, using both methods can help mitigate the risks associated with relying solely on one method, such as crop failure due to adverse weather or degradation of forage quality during storage. The findings above concur with those of Aranguiz and Creemers (2019); Feyissa *et al.* (2018); Kiggundu *et al.* (2014) and Muinga *et al*. (2015) who noted that both silage and hay forage conservation methods are still low due to lack of hay making equipment, high costs, challenges in silage making resulting from high temperatures that result in rapid deterioration at different stages of handling, storing, and feeding.

**Factors influencing the probability to be the included in innovation platform training on feed establishment, conservation and formulation**

A logit regression model was used to identify the factors that influence the probability to be the included in innovation platform training on feed establishment, conservation and formulation. Table 3 shows that education level of household head (z= 3.73), land size under dairy farming (z= 2.39), experienced shortage of feeds (z=2.71) and trained on silage making (z=2.3) positively and significantly influenced the likelihood of smallholder dairy farmers' participation in innovation platform training on feed establishment, conservation and formulation at 1%, 5%, 1% and 5% level, respectively.

On the other hand, work of household head (z=-1.97) and distance to nearest output market (z=-1.9) have shown negative and significant effect to participate in innovation platform training on feed establishment, conservation and formulation at 5% and 10% level, respectively. Factors such as the gender of household head, age of household head, experience in dairy farming, total milk produced in litres, livestock breed, access to credit, access to extension and Trained on hay making were not significant in explaining the probability of being included in innovation platform training on feed establishment, conservation and formulation.

Estimates for the probability of being included in the innovation platform training indicates that participants who had higher education level had more chance to be included in the training, this may be associated to access to knowledge and skills on benefits of engaging in feed establishment, conservation and formulation. Participants who large acreage under dairy farming had also more chance to be included in the innovation platform training. Land is a proxy for household asset which means smallholder farmers who had large parcels would allocate more land for forage production thereby necessitating them to engage in innovation platform training so that they can implement the skills and knowledge in feed establishment, conservation and formulation.

Experienced feed shortage and trained on silage makingare other two predictors farmers' participation in innovation platform training. An increase in feed shortage necessitates smallholder dairy farmers to look for alternative sources of feeds hence increasing their probability to participate in the innovation platform training. In addition, if a farmer has been trained on silage making, it increases their probability to participate in innovation platform training on feed establishment, conservation and formulation since they already know the benefits of these strategies.

On the other hand, work of household head and distance to nearest output market has shown negative response to innovation platform training. Work of the household head was a dummy variable (1=off-farm, 0=on-farm). If household head work off-farm, the probability of participating in innovation platform reduces due to other engagement which are not related to the farm. However, participation in off-farm activity is considered as a proxy for off-farm income which implies household engaged outside the farm have extra income which they can use to purchase feeds hence do not need training on feed establishment, conservation and formulation. An increase in distance to nearest output market reduces the probability of participating in innovation platform training, this is due to lack of market access and information access hence they tend to engage in subsistence farming.

**Table 3. Estimates of participation in innovation platform training on feed establishment, conservation and formulation**

| Training in innovation platform | Coef. | Std. Err. | z | P>z |
|---|---|---|---|---|
| Gender of household head | 0.434 | 0.616 | 0.7 | 0.481 |
| Age of household head | -0.022 | 0.031 | -0.72 | 0.470 |
| Work of household head | -1.494 | 0.758 | -1.97** | 0.049 |
| Experience in dairy farming | -0.026 | 0.026 | -1.01 | 0.312 |
| Education level of household head | 1.066 | 0.286 | 3.73*** | 0.000 |
| Total milk produced in litres | -0.105 | 0.068 | -1.54 | 0.125 |
| Livestock breed | -0.654 | 0.808 | -0.81 | 0.418 |
| Distance to nearest output market | -0.369 | 0.195 | -1.9* | 0.058 |
| Access to credit | -1.192 | 0.946 | -1.26 | 0.208 |
| Access to extension | 1.102 | 0.756 | 1.46 | 0.145 |
| Land size under dairy farming | 2.283 | 0.954 | 2.39** | 0.017 |
| Experienced shortage of feeds | 1.797 | 0.663 | 2.71*** | 0.007 |
| Trained on hay making | 0.798 | 1.099 | 0.73 | 0.468 |
| Trained on silage making | 3.337 | 1.453 | 2.3** | 0.022 |
| _cons | -2.283 | 3.047 | -0.75 | 0.454 |

Pseudo $R^2$ = 0.4187; Log likelihood = -40.29212; LR chi2(14) =58.05; Prob > chi2 = 0.0000

**Note: *, ****, and ******* represent significance levels at 10%, 5% and 1% respectively.

## Effect of innovation platform training in feed establishment, conservation and formulation on milk productivity

Table 4 presents the milk productivity for smallholder farmers who were trained in innovation platform and those who were not trained. The results indicate training on feed establishment, conservation and formulation under the innovation platform affects milk productivity of the two groups of farmers. Farmers who were trained under the innovation platform had an average milk productivity of 14.10 liters after the training, compared to 9.72 liters for those who did not. The results indicate a significant difference in milk productivity between the two groups, with farmers who underwent training showing higher levels of productivity than their non-trained counterparts. This finding highlights the potential advantages of feed establishment, conservation and formulation education for raising dairy farmers' milk production. The observed variations in milk productivity between the trained and untrained groups could be caused by a number of variables. Farmers that receivedfeed establishment, conservation and formulation training are probably better able to optimize their feeding procedures, which include choosing, harvesting, storing, and formulating rations for their animals. Trained farmers can increase milk production levels by feeding their livestock a consistent and healthy diet by using more effective feed conservation practices. Furthermore, farmers' understanding of the value of a balanced diet and appropriate herd management techniques may increase as a result of feed establishment, conservation and formulation training, improving the health and welfare of animals. The observed disparities in milk production between the two groups are further explained by the likelihood of higher milk outputs from healthy and well-fed dairy cattle. Further statistical analysis was conducted on the milk productivity after training data involved two main tests: Levene's Test for Equality of Variances and the t-test for Equality of Means as shown in Table 5. These tests aim to determine whether there are significant differences in milk productivity between the two groups of farmers: those who received training on feed conservation and those who did not. To determine whether there is a significant difference in the variances of the milk productivity ratings between the two groups, Levene's Test for Equality of Variances was performed. The Levene's test statistic ($F = 3.326$) is significant at $p < 0.05$ ($p = 0.071$), suggesting that the assumption of equal variances is not met, according to the data. To establish if there is a significant difference in the mean milk productivity ratings between the trained and untrained groups of farmers, the t-test for equality of means was used.

The t-test statistic ($t = 3.882$) is significant at $p < 0.05$ ($p = 0.000$), indicating a substantial difference in milk productivity between the two groups. These results support the hypothesis. The statistical analysis's findings indicate that farmers who underwent feed conservation training produced noticeably more milk than those who did not. These results highlight the critical value that education and skill development play in advancing agricultural practices and livelihoods and support the efficacy of feed conservation training in raising milk productivity among dairy farmers. Oguntoye *et al.* (2020), established consistent finings indicating that farmer training on feed conservation is key as it enhances their milk production. Notably, farmers are able to conserve their animal feeds which in the long run cushions them against periods of shortage of natural pasture. Alonso *et al.* (2018) further indicates that training dairy on feed conservation bores more fruits such as milk safety and general economic improvement in productivity. This means that such trainings bring about a positive impact in milk production. According to Alonso *et al.* (2018) farmers were trained on conservation practices such as storage, adequate mixing of different nutrient portions, harvesting and efficient quantities of feeding animals which in the end resulted to higher milk production from the dairy animals.

**Table 4. Milk productivity after training**

| Variables | Farmers trained on feed establishment, conservation and formulation | Frequency | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Milk productivity after training (litres) | Yes | 50 | 14.10 | 4.867 | 0.688 |
| | No | 50 | 9.72 | 6.321 | 0.894 |

**Table 5. Effect of feed establishment, conservation and formulation training on milk productivity**

| Independent Samples Test | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
| | | F | Sig. | T | Df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
| | | | | | | | | | Lower | Upper |
| Milk productivity after training | Equal variances assumed | 3.326 | 0.071 | 3.882 | 98 | 0.000 | 4.380 | 1.128 | 2.141 | 6.619 |
| | Equal variances not assumed | | | 3.882 | 91.983 | 0.000 | 4.380 | 1.128 | 2.139 | 6.621 |

To ascertain the statistical relationship between the independent variables (innovation platform training in feed establishment, conservation and formulation) and dependent variable (milk productivity). The results of regression analysis are shown in Table 6.

**Table 6. Regression analysis effect of innovation platform training on milk productivity**

| | Coefficient | Std. Err | t | p-value |
|---|---|---|---|---|
| Innovation Platform Training | 4.38 | 1.128 | 3.88 | 0.000 |
| _Constant | 9.72 | 0.798 | 12.18 | 0.000 |

a) Dependent variable (milk productivity)
b) Predictors (innovation platform training in feed establishment, conservation and formulation)

The results on effect of innovation platform training in feed establishment, conservation and formulation indicated that β= 4.38, and P-Value= 0.01 at 95% confidence level. This implies that predictor variables (Innovation Platform Training) had a positive effect milk productivity. The β value of 4.38 implies that a unit increase in innovation platform training in feed establishment, conservation and formulation will increase milk productivity by 4.38 units. The control group exhibited significantly higher milk productivity compared to the non-control group. From the study findings, it is notable that feed establishment training on dairy farming has a positive impact on milk productivity. During training, important skills are passed on to the dairy farmers through knowledge sharing, skills enhancement and quality feed establishment techniques which eventually leads to an increase in milk productivity. As it suggests, training interventions are key in improvement of milk productivity among smallholder dairy farmers.

Findings by Leggesse *et al.* (2023), Lemma *et al.* (2021) and Smith *et al.* (2019) conform to the findings of these study by documenting the fact that through farmer trainings in feed establishments, there is a positive effect of increase in milk yield for smallholder dairy producers. Trainings on feed establishments are critical in ensuring farmers are well equipped with knowledge on effective feed handling to avoid contaminations and production of high-quality feeds that ensure adequate animal health for efficient milk production. Trainings on proper storage of feeds during feed establishments have also enabled farmers to avoid dairy feed loss through contaminations and spoilage thus ensuring their animals have adequate supply of feeds that subsequently increases their milk productivity. These results highlight the critical value that education and skill development play in advancing agricultural practices and livelihoods and support the efficacy of feed conservation training in raising milk productivity among dairy farmers. Ongadi*et al.* (2020) established consistent finings indicating that farmer training on feed conservation is key as it enhances their milk production. Notably, farmers are able to conserve their animal feeds which in the long run cushions them against periods of shortage of natural pasture.

Alonso *et al.* (2018) further indicates that training dairy on feed conservation bores more fruits such as milk safety and general economic improvement in productivity. This means that such trainings bring about a positive impact in milk production. According to Alonso *et al.* (2018) farmers were trained on conservation practices such as storage, adequate mixing of different nutrient portions, harvesting and efficient quantities of feeding animals which in the end resulted to higher milk production from the dairy animals. These results are also in conformity with a study done by Kashongwe *et al.* (2017), who found out that feed formulation training had a positive effect on the milk productivity of dairy farmers. Additionally, the study further indicates that aside from feed formulation training, it is vital for the farmers to also be training on animal health involving around feed formulation and milk hygiene. Similar findings were also documented by Ashagrie *et al*. (2023); Hatew *et al.* (2023) and Maleko *et al.* (2018) noting that effective milk production in commercial smallholder dairy farms is often as a result of positive trainings on feed formulations and the willingness of the dairy farmers to learn and practice it out. Generally, this shows that participation in innovation platform that offers capacity building to smallholder farmers increases their awareness, knowledge and skills concerning feed establishment, conservation and formulation.

**Conclusion and Recommendations**

The purpose of this study was to examine effect of innovation platform training in feed establishment, conservation and formulation on milk productivity of smallholder dairy farmers in Kenya. Overall, it can be concluded that farmers who received training on feed establishment, conservation and formulation under the innovation platform had higher average milk productivity, compared to those who did not.From the regression analysis, it can be concluded that participation in innovation platform training increases milk productivity by 4.38 units. These findings suggest the importance of providing targeted training programs to enhance farmers' knowledge and skills in feed establishment, conservation and formulation, ultimately leads to improved dairy production outcomes.By equipping farmers with the necessary knowledge and skills, they can effectively mitigate feed shortages, improve livestock productivity, and enhance the sustainability of dairy farming systems in the region. The study recommends that the government and other stakeholders should support innovation platforms in implementing training interventions that aim to improve farmers' productivity and income. Moreover, there is need to increase investment in strengthening the extension services to provide farmers with technical support, training, and knowledge sharing on modern dairy farming practices, including forage management, animal health, and value chain dynamics.

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